THE JOURNAL OF ENGINEERING EDUCATION

Published by the Society for the Promotion of Engineering Education

Published under the Supervision of the Publication Committee.
H. S. Boardman, R. I. Rees, F. L. Bishop, Editor, University of Pittsburgh.
Published at Prince and Lemon Sts., Lancaster, Pa.

Entered as second-class matter at the Post Office at Lancaster, Pa., under the Act of March 3, 1870.

New Series
Vol. XXI, No. 7. MARCH, 1931 Subscription Price, $3.00 per year. Single Copies, 50 cents.

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TECHNICAL INSTITUTE EDUCATION IN AMERICA*

IN THE UNITED STATES

By ROBERT H. SPAHR

General Motors Institute of Technology

Three groups of resident institutions in the United States are at present operating in the post-secondary age and preparation levels of engineering education—the four-year colleges, the technical institutes, and the junior colleges. The four-year engineering colleges number close to 150, the technical institutes between 30 and 40, and the junior colleges, offering engineering or pre-engineering courses, approximately 100.

At the present time, practically all of the junior college programs are intended primarily to prepare for the third and fourth years of the four-year college; in contrast, the technical institute programs invariably are intended to train for rather immediate employment in responsible technical and supervisory positions. Both groups of schools deal almost wholly with briefer technical courses, yet these courses differ in type as well as in objective.

One recognizes in the technical institute area three rather distinct types of curricula: (1) engineering courses which parallel the college courses but in briefer, more direct, intensive, and practical forms; (2) courses in the technology of specific industries; and (3), courses preparing for particular technical functions.

These technical institute courses are more directly technical than are those of the junior and four-year engineering colleges, yet they include a substantial treatment of the underlying and related sciences, and usually some work in English and economics. The practice actually of *doing to learn* is an important characteristic of the instruction; a considerable portion of the student's time in school is devoted to practice in laboratories, shops, drawing, and design. Students are admitted to these courses primarily on evidence of their capacity, interest, and in some instances future employability rather than on formal scholastic credentials.

These courses are usually devised to meet the needs of those having a fairly settled vocational aim, those who for financial reasons cannot spend four years or more in preparation for remunerative employment, and those of mature age who from practical experience have discovered their technical bents and have realized the need for

* Presented at the Annual Meeting of the Society for the Promotion of Engineering Education, Montreal, June 28, 1930.

systematic technical education; further, these courses point to the higher practical pursuits of industry rather than to the specialized intellectual functions of research and analytical design.

Certain historical influences probably caused the colleges to outgrow and overshadow the technical institutes in America, the reverse of the experience abroad; but while outdistanced in numbers, several of the technical institutes in America are notably successful as measured by results.

By virtue of the characteristics of technical institute education and its close relation to industry, the major development to date has come in that part of the United States east of the Mississippi and north of the Ohio and Potomac rivers. At this time there appears to be going on a definite and positive development of technical institute education in the newer industrial areas, notably California. On the other hand, the major development of the junior colleges has occurred in the south, central west, and west, with relatively few in the northeast section of the country.

About 57 per cent of the present institutes are operated privately; slightly more than half of these have endowments which range in amounts from those able to care for a large part of the institutional expense to those whose incomes assist little in operating the school. Slightly less than half of the private institutes have no endowments, and these operate on a self-sustaining basis.

Of the present institutes 33 per cent operate under public auspices, either state or city, and 10 per cent enjoy both private and public support. By way of comparison, in 1923, private junior colleges outnumbered publicly supported junior colleges about two to one.

An analysis of the programs of thirty of the institutes shows that the major part of the technical institute instruction of sixteen is conducted as regular full-time day instruction, the work of six as evening instruction, of six as extension or correspondence instruction, of two by the coöperative method.

The lengths of the courses, for the satisfactory completion of which diplomas or certificates are granted, vary from one to three years measured by full-time day instruction; no course less than one year in length measured by this standard was considered in the S. P. E. E. technical institute study. The courses average approximately two years.

The institutes which operate on the full-time day basis run about thirty-six weeks per year, and the students average thirty-three clock hours per week with instructors.

The curricula in a large number of the institutes appear to have been influenced largely by the objectives in the minds of the founders, and in others by the influence and personality of the present

administrations. In some instances there are distinct indications that the objectives of the founders have been radically changed by later administrations; indeed, in some instances this may have been through necessity.

The one question raised most frequently during the study had to do with the content of the curriculum. That is, whether the right subject matter, in the correct proportional amounts, extending over proper periods of time, for maximum effectiveness, is being taught. These items are of far greater significance in the building of a shorter terminal-point curriculum of one or two years in length than in a longer curriculum of four years. In the former, time very definitely dominates the situation. There is only time available to give instruction in essentials thought to be necessary to attain certain predetermined objectives.

The shorter the course the more rigid must be the schedule of studies. There is little opportunity for the student to substitute subjects or choose electives. The curriculum offered is expected to be the one best and quickest path to a particular objective; its construction requires experience and skill which the student necessarily lacks. The terminal character of these courses is another reason why it is necessary to be exacting, inclusive, and careful in the laying out of the curriculum. As the course becomes more definite in purpose or objectively vocational, the more inflexible must be the curriculum.

A few believe that they have solved these curriculum questions in a manner satisfactory to themselves through systematic study and experimentation; but a solution in one case may not answer in all cases. In this area of education, for every school which has solved its curriculum problems satisfactorily to all concerned there are five which have not. Several institutions in this area have been eminently successful in attaining desired objectives, the majority have reached a fair degree of success, while a few are groping aimlessly. Many of the uncertainties which exist may be attributed in part to the relatively brief period in which most of these institutions have operated; there were few graduated prior to 1900, the growth having occurred largely since the war period. The junior colleges because of their primary objectives and rapid development have adopted the curriculum of the first two years of the college or university; however, there is, at this time, a definite move on foot to study their curricula from the standpoint of the needs.

Beginnings have been made in more scientifically planning and building curricula. Several experiments in this direction are now in progress which deserve watching. One of these is in the technical institute area. This technical institute is revising its curricula through the aid of so-called job analysis. It is not more

than reasonable to expect that a school may more effectively and efficiently strike at its goal if it knows the duties and responsibilities which the graduates meet in actual practice.

No universal title applies to the administrative heads of these institutes as is the general practice in colleges; those in common use are president, director, and principal. The administrations, in general, exert more definite and positive control over the workings of the school than do the administrations of the colleges and universities. The control probably parallels more closely the business organization than it does college procedure. This makes it possible to make changes more easily and obtain more direct action when and where needed. It appeared quite clear that the most successful schools were those which happened to have the highest degree of centralized control.

Professorial titles are practically never used in the institutions whose major work lies in the technical institute area. They have supervisors and heads of departments, but few other designations. Thus they probably pay salaries in legal tender instead of by titles.

Costs, and particularly comparative costs, are difficult to obtain, and at best only general conclusions are possible.

	Minimum	Average	Maximum
5 Technical Institutes (1928–29)	$275	$411	$450
9 Four-Year Engineering Colleges (1925–26)	$264	$571	$712

The average estimated cost per student per year, excluding interest on plant, in 1928–29 for five technical institutes was $411, while this same cost for nine four-year engineering colleges in 1925–26 was estimated to be $571, which is 39 per cent higher than the average and about 29 per cent higher than the maximum estimate of the technical institute cost. However, the minimum technical institute cost slightly exceeds the minimum four-year engineering college cost. In this connection it is interesting to note that the maximum estimated cost per student per year, excluding interest on plant, from fifteen junior colleges in 1922–23 is less than the minimum for either the technical institutes or the four-year engineering colleges just cited.

The indications are that technical institute education is costing at present slightly less than four-year engineering college education, yet if done well there is reason to believe that it will cost practically as much as engineering college education. In general, if funds are inadequate to run four-year engineering colleges, they

are, likewise, inadequate to operate technical institutes, though exceptions may exist.

An analysis of the faculties shows that about 25 per cent of the members of the technical institute staffs have no degrees compared to about 14 per cent for the four-year engineering colleges. The majority of the members without degrees in both technical institutes and colleges are found in the shops, or teaching other practical and applied subjects. In one of the schools, recognized as one of the most efficient in the technical institute or any other area of education, 86 per cent of the faculty have no degrees, but all are graduates of the institution itself.

Every teacher in the study reported has taken some course beyond high school, or of an adult nature; 71 per cent have had four or more years beyond high school; 18 per cent have had graduate courses ranging from one to four years. In nearly 100 per cent of the cases, they have had practical experience ranging from one to thirty-five years before being employed as members of the faculties.

Of the faculty members, 62 per cent hold membership in professional societies; 85 per cent of the members of one faculty hold membership in one or more professional societies. About 15 per cent of all faculty members in this area of education are members of the S. P. E. E.

In general, the clock hours of teaching per week are larger than in the the four-year engineering schools and much above those in the liberal arts colleges, and the number of students per section for class room is very frequently 35 to 40.

Where both day and evening classes are held, teachers commonly have part of their work in each division. In these cases they either receive extra compensation or have their hours of evening work counted in their weekly schedules.

The amount of original productive work is considerable; more than 25 per cent of the teachers have publications of some form to their credit, and 20 per cent have made one or more inventions. Many on the faculties of the full-time schools maintain a considerable amount of consulting practice. The largest case noted was $10,000 a year from consulting fees.

The median age of the teachers is close to 35, and the median period of teaching experience is between seven and eight years.

Data covering three full-time staffs exemplifying the best standards cover a range of individual salaries from $1,900 to $6,000 a year with medians of $3,600, $3,100, and $3,000 respectively.

The rates for evening school teaching are seldom proportional to these rates. But one individual, teaching in the evening, reported a normal salary beyond $5,000 and the modal group lies between

$2,500 and $3,500. It appears that much evening teaching is plainly a means of earning extra income adopted by fairly low salaried men in practice, though some notably successful teachers are found in this group. In class visitations, by far the best teaching was observed in the full-time day classes, and by far the poorest, with one exception, was observed in extension and evening teaching.

Considering all of the schools in this area of education, nearly one half of the alumni and present students had practical experience in the field of work for which they expected to prepare themselves. Considerably more had experience in some form of employment. The average age of technical institute students at graduation is not far from the average age of four-year college students at graduation; this indicates at least, an interval of employment of from one to three years between high school and entrance to the technical institute. These factors have undoubtedly assisted them in forming rather definite objectives. In one particular study of 629 alumni it was found that at the time of entering the institutes 68 per cent had a specific field of work in mind for which they expected to prepare. When asked why they chose to attend these institutes, when on the whole about three out of four had adequate preparation to enter four-year colleges, eighteen reasons were advanced; the dominant one was "believing personally in the results of this type of education."

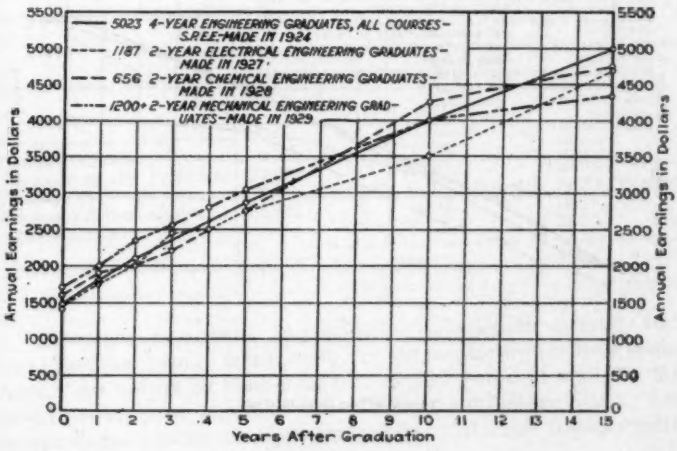
It will be interesting to note that advertisements in current literature, in general, did not influence the decisions of many attending these schools. It is not uncommon for institutions in all areas of education to advertise their courses. Comments from alumni reflected no criticism of the amount of advertising but did reflect criticism of some particular types. It is gratifying that the literature and advertisements of the institutions falling within the scope of our study, with but few exceptions, were found to follow facts closely, and only a very few might have been termed misleading. Here it may be well to state that the chief offenders in misleading and probably non-factual publicity happened to fall within other areas of education.

The reputation of the school influenced 75 per cent of the alumni; this has increased to 85 per cent for the present students.

Of the graduates of five of the institutes, 53 per cent paid more than one-half of their expenses, and 42 per cent paid more than three-fourths of their total expenses. This may indicate that lack of means for a longer course played a part in their choice.

It was found that, leaving out of account all purely personal considerations, the alumni have not found the absence of a college degree a tangible handicap in obtaining employment, advancement, and recognition by professional and business organizations.

The earning power of the graduates of the more efficient technical institutes parallels quite closely that of the engineering college graduates of the same maturity. It is surprising that there is no greater difference between the median earnings of the one, two, and four-year graduates. The earnings in after years are certainly not in direct proportion to the lengths of the courses. The graduates appear to be in considerable demand. For example, one school has a standing order from a large concern for five graduates each year, who are accepted without interview, on the basis of the school's recommendation.


5023 4-YEAR ENGINEERING GRADUATES, ALL COURSES—S.R.E.E.—MADE IN 1924
1187 2-YEAR ELECTRICAL ENGINEERING GRADUATES—MADE IN 1927
656 2-YEAR CHEMICAL ENGINEERING GRADUATES—MADE IN 1928
1200+ 2-YEAR MECHANICAL ENGINEERING GRADUATES—MADE IN 1929
Annual Earnings in Dollars
Years After Graduation
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

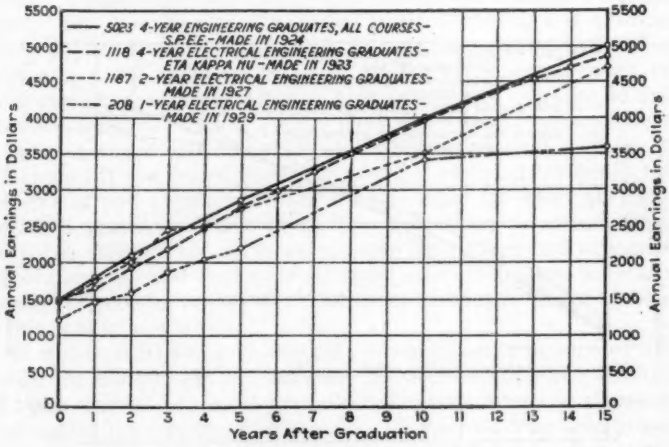
Median Earnings

A valuable index as to the effectiveness of a particular type of education is found in the reactions of its graduates. Graduates from twenty-five years ago to the present are fairly unanimous that they would go to the same type of school and take the same type of course if they had to do it over again.

Of all the evidence gathered, that which deals with the requirements of industry is probably the most conclusive.

An attempt was made to determine the needs for technically trained men in business and industry. Employers were asked to study and analyze their needs in terms of ratios of technical institute graduates to four-year engineering college graduates. It is significant, almost incredible, to find four ratios, resulting from four studies conducted at different periods under different circumstances in different industries even in different parts of the coun-

try, so nearly alike in size respectively 2.8 to 1, 2.7 to 1, 2.7 to 1, and 2.6 to 1. This means that industry says that to operate efficiently, it should have 2.7 technical institute graduates to 1 four-year college graduate. Roughly, the manufacturing industry has indicated that from 6 to 8.3 per cent of its total employees should be technical institute graduates; that from 2.2 to 3 per cent of the total employees should be four-year college graduates; and, that about 15 per cent should be trained in elementary manual and industrial courses.


5023 4-YEAR ENGINEERING GRADUATES, ALL COURSES - S.P.E.E. - MADE IN 1924
1118 4-YEAR ELECTRICAL ENGINEERING GRADUATES - ETA KAPPA NU - MADE IN 1923
1187 2-YEAR ELECTRICAL ENGINEERING GRADUATES - MADE IN 1927
208 1-YEAR ELECTRICAL ENGINEERING GRADUATES - MADE IN 1929
Annual Earnings in Dollars
Years After Graduation
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500

Median Earnings

In order to check the results obtained, an inquiry was made of fifteen representative companies, located in eleven states, which were known to have experience with both technical institute and college graduates. These companies were asked whether from their experience they felt that there was an area of terminal education, intermediate in duration between vocational and trade schools on the one hand and engineering colleges on the other, needing to be encouraged and developed in America. The replies were unanimous in the affirmative. The relative importance of the aims of technical institute training, as indicated by the composite replies of these fifteen companies, is as follows:

1. To qualify men for supervisory positions in operating departments.
2. To qualify men for technical services such as drafting, designing, testing, inspection.

3. To qualify men for commercial positions relating to the sale of technical products and services.

A significant fact which cannot escape attention is that four-year college trained men do not enter the production function of industry in large numbers. In contrast, the largest numbers of technical institute men enter production. Industry contends that there is not only a vital need for technically trained men in production but that there are excellent opportunities as well.

DISTRIBUTION BY FUNCTIONS OF GRADUATES OF COLLEGES AND OF TECHNICAL INSTITUTE COURSES

Groups of Positions, or Functions	15,094 College Men in Technical and Supervisory Positions	1,398 Shorter Course—Technical Institute Men (Electrical) in Technical and Supervisory Positions	325 Shorter Course—Technical Institute Men (Textile) in Technical and Supervisory Positions
General Officers	9.9%	11.1%	22.5%
Engineering and Technical	33.0%	26.0%	20.0%
Production	9.0% (Lowest)	33.0% (Highest)	24.3% (Highest)
Sales and Advertising	38.1%	6.1%	10.1%
Miscellaneous	10.0%	23.8%	23.1%
	100.0%	100.0%	100.0%

There are, at present, approximately one-fiftieth as many technical institute men in manufacture as the employers say they should have. An output of from 15,000 to 20,000 technical institute men could probably be absorbed annually in manufacture alone. Less comprehensive estimates from the public utility and transportation industries indicate demands in proportion.

There are fields, such as engineering, which the technical institutes, or shorter course institutions, may divide with the four-year engineering colleges in fairly equal proportion. However, in order to serve more completely the needs and create for themselves a permanent place in the technical education program, these institutions will need to serve a group of purposes quite distinct from those of the four-year engineering colleges.

The following are possibilities for development in technical institute education:

1. Technical education, not trade training, for particular industries or functions rather than professions, such as textile manufacturing, coal mining, printing, power plant management, and production engineering. There is a growing need for a type of technical education for foremen, inspectors, maintenance men, and superintendents in production and plant departments.

2. Technical education for numerous semi-professional positions, for contracting and construction, for selling, installing, servicing technical appliances, and for proprietorship.

3. Technical education for young men who have been employed and wish training for immediate ends. The four-year college course does not appear as suitable for such men as does the technical institute course.

4. Technical education adapted to young men with limited time and money, with generally practical and mechanical tastes, or with preparatory education lacking some of the more academic subjects, and for superior graduates of vocational courses and continuation and trade schools.

These four fields indicated, together with others, are largely unprovided for in the present educational system. This is a vast field of service, mainly in the post-secondary age and preparation levels of education, waiting to be developed.

The technical institute courses are well suited to meet these needs. The junior college courses are not now well suited, but might be made more so by changing their curricula, where conditions justify, to prepare men for immediate and effective employment rather than for more advanced instruction; provided also, that adequate equipment, together with practical and qualified teaching personnel are available. It must not be forgotten that it is far simpler, easier, and less expensive to give the usual junior college engineering work than the technical institute type.

The coöperative plan, alternating periods in school and at work, which is probably of limited applicability at secondary age levels, appears to be well adapted to the aims and work of the technical institutes. It eases the economic burden on student and school alike and affords a highly desirable trial of aptitude and orientation to industry, without necessitating a break in the continuity of education.

There is the same place in the technical institute area of education for the independent endowed institute as for the endowed college in its field. Independence of public control enables the institution to experiment, work on a selective plan, and set standards with ideals of special excellence rather than of the broadest possible public service.

It appears that no field or area of education in America offers the same possibilities for development and service which the technical institute area does. People with money who have a desire to endow educational institutions could probably find no more effective means of real worthwhile service than this area of education.

It seems clear, however, that the actual needs and potential de-

mands are so great that they may be met only by public institutions with a definite place in state and city education system. European experience tends to support this position.

Associating a technical institute giving higher terminal courses with a technical high school has not yet been tried, so far as is known. It appears practical and might go far toward solving the problem of adequate development of technical education of this character over the country as a whole. Experience tends to discourage the operation of a technical institute course parallel with the four-year degree granting engineering course on the same campus, under the same administration, and under the same faculty. No experiment along this line has yet proved satisfactory.

There are at least half a dozen developments in this area of education being considered at this time, and in each case the speaker has advised that careful consideration be based upon the study of the facts, and has discouraged at all times the attempt to organize such an institution without adequate funds looking toward permanency. It seems quite clear that in order to develop as they deserve, more of these schools and courses in this area of education need to be organized around more specific and more clearly visualized aims.

Technical education, be it short or long course type, engineering or technological in character, is so important that it must have adequate representation in the formulating of educational policies whether they are city, state, or national.

Technical education is that upon which the motivating spirit of industry is built, and it teaches the principles by which industry progresses. Without successful and efficient industry America would be placed in an unfavorable position.

In the forthcoming S. P. E. E. report, Vol. II, a fuller discussion, illustrated by much interesting data, together with interpretations by the staff, will be found.

IN CANADA

By AUGUSTIN FRIGON

Director-General of Technical Education for the Province of Quebec

When I was invited to talk to you on institutes of less than college degree, I was given a very easy task, because although we have a good many technical high schools and trade schools in Canada, outside of the Province of Quebec there is only one institute of that type, and that is the Calgary Institute of Technology and Art. That Institute was founded in 1916, and last year it offered

courses in the following subjects, in order of importance as far as number of students enlisting: tractor engineering electrical engineering, dressmaking and millinery, farm mechanics, telegraphy, automatic electricity, drafting, machine shop, and industrial art. That Institute is, what you would call, I believe, a very high-grade trade school.

In Quebec, we have what I would classify as really genuine technical schools. In 1907, the Quebec Legislature passed a law providing for the creation of technical schools. A gentleman who had been one of the prominent men in technical education in France was engaged to organize these schools. He founded the Quebec, the Montreal and the Three-Rivers schools. Since then the Hull School has opened. These schools are owned and operated by the Provincial government and they receive a fixed amount each year from the city in which they are located. The Provincial government supplies whatever amount is necessary to keep the school going.

These schools offer a variety of courses. They have the standard evening classes. This year, in Montreal, we had 2,300 students enlisted in the evening classes. They have a two-year trade course, special courses for automobile mechanics, and others of that character. There is at the Montreal School a part-time apprenticeship course in typography. Their most important work however is a three-year course for "technicians," or in other words, a technical course. Students are admitted in that three-year course from the second year of high school, and they receive a general training in technology and shop practice. During their first year they spend about three quarters of their time in the classroom and the rest in the machine shop, the woodworking shop, the smithy and the foundry.

During the second and third years, half their time is spent in the classroom and laboratories, and the rest in the one shop in which they have chosen to specialize—the machine shop, the woodworking shop, the foundry, the smithy or the electric shop.

There is one characteristic of our schools which might interest you and that is that they are strictly bilingual. A boy has the privilege of studying either in French or English. All of our activities are double. We do not organize one course without providing for that course being given in the two languages. In Montreal, all instruction is given in French and in English, to different groups. In Quebec and Hull we have few English-speaking pupils. In those schools we may have no English class for a year or two, and then we may have to follow one or two pupils through their course with an English section. Every teacher must be able to give instruction in both English or French. Of course, we

try to give English teachers to English boys, and French teachers to French boys, but every professor or instructor must be prepared to step in and take the place of any colleague who might be away temporarily. You will understand that they constitute a problem in recruiting our personnel. We can easily find English teachers on this continent, but when it comes to getting a teacher who can talk both French and English, it is not as easy.

Another point about these schools is they are strictly for boys, and their curriculum is limited to what you might call the electro-mechanic art. We have no commercial and no home economic courses of any sort.

I told you my task would be very easy and here is why. Last year we prepared a moving picture which is supposed to illustrate very clearly the character of our technical course. We have taken one special problem, as you will see, and we follow the problem as it is studied by the students in their different classes and shops. I think if I show you this film it will tell you more about what we have in mind in our curriculum and methods than I could tell you in two hours talking. You will notice that this one problem is more particularly connected with the machine shop.

Showing of Film

Gentlemen, this film was not prepared to be shown to such a gathering as this. However, we have tried to show that we are trying to be very thorough in our work and to give our students a thorough instruction in science, technology, mathematics, and manual training. We have wonderful machine shops which are organized as industrial shops would be in any big industry. The school is open for inspection and by looking it over, you will have a good idea, I am sure, of what we do in this Province in technical education of less than college grade.

THE 1931 SESSIONS OF THE SUMMER SCHOOL FOR ENGINEERING TEACHERS

BY H. P. HAMMOND

Director of Summer Schools

The two sessions of the Summer School for Engineering Teachers for 1931 were announced in the December, 1930, number of the *Journal of Engineering Education.* Since that announcement the programs have been practically completed and the staffs recruited. The present article is written for the information of the members of the Society in general, and in particular for those who may plan to attend either of the sessions.

Session on Chemical Engineering. The session for teachers of chemical engineering will be held at the University of Michigan, Ann Arbor, Michigan, from June 23 to July 9, inclusive. It will be followed by a conference on chemical engineering education, held under the sponsorship of the American Institute of Chemical Engineers, at Ann Arbor, on July 10 and 11. A trip of inspection to industries of the Pittsburgh district, which will be optional for those in attendance, will be held on July 13 to 15, inclusive. During the stay in Pittsburgh, the headquarters of the group will be at the Mellon Institute of Industrial Research.

The program of the chemical engineering session is divided into four principal divisions, as follows:

1. The Teaching of Chemical Engineering and Allied Subjects
2. The Application of the Principles of Chemical Engineering in Industry
3. Laboratory Work in Chemical Engineering
4. Historical and Miscellaneous

Some idea of the nature of the various portions of the program can be secured from the following excerpts:

Wednesday, June 24

8:15 A.M. The Place of the Teaching of the Unit Processes in a Chemical Engineering Curriculum. W. K. Lewis

10:00 A.M. The Nitrogen Situation. H. A. Curtis.

1:30 P.M. The Place of Laboratory Work in a Chemical Engineering Curriculum. W. L. Badger.

2:30 P.M. Inspection of the Chemical Engineering Laboratories of the University of Michigan.

Thursday, June 25

8:15 A.M. The Teaching of the Principles of Distillation. W. K. Lewis.

10:00 A.M. Petroleum Refining. R. E. Wilson.

1:30 P.M. Historical Development of Chemical Engineering. W. L. Badger.

Friday, June 26

8:15 A.M. The Teaching of Fluid Flow and Fluid Measurement. R. S. Tour.

10:00 A.M. Recent Development in Food Industries. L. V. Burton.

1:30 P.M. Discussion of Laboratory Experiments on Fluid Flow. H. L. Olin.

2:15 P.M. Discussion of Laboratory Experiments on Distillation. J. R. Withrow.

Saturday, June 27

8:15 A.M. Price Trends in the Chemical Industries. S. D. Kirkpatrick.

10:00 A.M. Teaching of Heat Flow (general, except radiation). J. C. Olson.

P.M. Recreation.

It will be noted that three divisions of the program are carried along in parallel: the teaching of the principles of chemical engineering; the organization and the teaching of laboratory work; and the applications of principles to industrial processes.

The program will be so arranged that those in attendance will secure not only general statements of the principles and methods of presentation, but will also have a complete and logically arranged set of representative problems of the principal chemical engineering processes with their solutions, which will be worked out and presented by members of the teaching staff.

As in past sessions of the Summer School, those in attendance will be supplied with complete sets of lecture outlines in mimeographed form, so that they will have at the end of the session a well arranged summary prepared by the ablest teachers in the field and by prominent practitioners.

While the staff of the session has not been completely recruited the following members can be announced:

A. H. White, University of Michigan, Local Director; W. L. McCabe, University of Michigan, Local Secretary.

Teachers of Chemical Engineering: A. H. White, W. L. Badger, and G. G. Brown, of the University of Michigan; W. K. Lewis and W. H. McAdams, Massachusetts Intitute of Technology; R. S. Tour, University of Cincinnati; H. L. Olin, State University of Iowa; J. R. Withrow and G. A. Bole, Ohio State University; J. C. Olsen, Polytechnic Institute of Brooklyn; Harry McCormack, Armour Institute of Technology; A. W. Hixson, Columbia University; G. H. Montillon, University of Minnesota; B. F. Dodge, Yale University; J. H. James, Carnegie Institute of Technology.

Practicing Engineers: H. A. Curtis, National Research Council; R. E. Wilson, Standard Oil Company of Indiana; L. V. Burton and S. D. Kirkpatrick, of McGraw-Hill Publishing Company; L. V. Redman, of the Balkelite Corporation, Bloomfield, N. J.; J. V. N. Dorr, of the Dorr Company, New York; Zay Jeffries, Aluminum Castings Company, Cleveland; C. O. Brown, Nitrogen Engineering

Corporation of New York; E. C. Sullivan, Corning Glass Works, Corning, N. Y.; and C. C. Furnas, Bureau of Mines Experiment Station, University of Minnesota.

As previously announced, the members of the chemical engineering session will be housed in Jordan Hall, a new dormitory of the University of Michigan, at a cost of approximately $17 per week.

In addition to the trip of inspection to industries in the Pittsburgh district, one entire day of the program has been set aside for a trip to the Ford Motor Company, at Detroit, at which plant there are many processes within the field of chemical engineering.

Session on Mathematics. The session for teachers of mathematics will be held at the University of Minnesota, Minneapolis, from August 24 to September 5, inclusive. The program is arranged in the following principal divisions:

1. General Principles of Teaching
2. Teaching of Mathematics to Engineering Students
3. Advanced Mathematics
4. Applications of Mathematics in Engineering Practice
5. Historical and Miscellaneous

Some idea of the specific nature of the program can be secured from the following illustrations:

Thursday, August 27
- 8:30 A.M. The Function of the Classroom Teacher. F. T. Spaulding.
- 10:15 A.M. Discussion—led by Louis O'Shaughnessy.
- 1:30 P.M. Representation of Functions by Series. Dunham Jackson.

Friday, August 28
- 8:30 A.M. Diagnosis of Student's Difficulties. F. T. Spaulding.
- 10:15 A.M. College Algebra—A Discussion of Course Content. W. E. Brooke.
- 1:30 P.M. College Algebra—Methods of Teaching. W. E. Brooke.

Saturday, August 29
- 8:30 A.M. Coördination of Mathematics with Related Engineering Subjects—A Symposium led by O. M. Leland.
- 10:15 A.M. Mathematics of Statistics. H. L. Rietz.

Monday, August 31
- 8:30 A.M. Analytic Geometry—Discussion of Course Content. W. J. Berry.
- 10:15 A.M. Analytic Geometry—Methods of Teaching. W. J. Berry.
- 1:30 P.M. History of Mathematics before the Seventeenth Century. R. C. Archibald.

Tuesday, Sept. 1
- 8:30 A.M. History of Mathematics after the Sixteenth Century. R. C. Archibald.
- 10:15 A.M. Differential Calculus—A Discussion of Course Content. E. V. Huntington.
- 1:30 P.M. Differential Calculus—Teaching the Nature of the Derivative. E. V. Huntington.
- 3:00 P.M. Differential Equations for Engineering Students—A Discussion of Course Content. Warren Weaver.

The staff of the mathematics session has been completely organized and is as follows:

O. M. Leland, University of Minnesota, Local Director; C. A. Herrick, University of Minnesota, Local Secretary.

Staff members: F. T. Spaulding and E. V. Huntington, Harvard University; E. R. Hedrick, University of California at Los Angeles; Louis O'Shaughnessy, Virginia Polytechnic Institute; S. P. Timoshenko, University of Michigan; Dunhan Jackson, W. E. Brooke and Dean M. E. Haggerty, University of Minnesota; H. L. Rietz, University of Iowa; W. J. Berry, Polytechnic Institute of Brooklyn; R. C. Archibald, Brown University; Warren Weaver and C. S. Slichter, University of Wisconsin; J. W. Young, Dartmouth College; T. C. Fry, Bell Telephone Laboratories; Charles N. Moore, University of Cincinnati; Leigh Page, Yale University.

The mathematics session will be followed immediately by the annual meetings of the American Mathematical Society and the Mathematical Association of America, which will also be held at the University of Minnesota beginning September 7. This arrangement has been made so that those attending the S. P. E. E. session who so desire may remain for the meetings of the mathematical societies.

As previously announced, the entire Summer School party will be housed in dormitories of the University of Minnesota at a cost not exceeding $35 for the two weeks.

The office of the Director of the Summer Schools is sending out at this time to presidents, deans, and heads of departments, announcements of the 1931 sessions. It is at this time that the largest number of applications to attend the sessions are received. It is advisable that those who expect to attend submit their applications promptly to the Director of Summer Schools, S. P. E. E., 99 Livingston Street, Brooklyn, N. Y.

METHOD OF TREATING THE SUBJECT OF PATTERN DESIGN AT THE UNIVERSITY OF ILLINOIS

By B. RUPERT HALL

Superintendent, Pattern Laboratory

Manufacturers and educators in the field of engineering are displaying considerable interest relative to just what training the engineering student should receive while in college. This inquiring attitude opens the way for constructive criticism of methods that have been and are now being employed in teaching the various manufacturing processes.

It is generally conceded that shop courses included in an engineering curricula are largely taught by stressing the manual phase of the work only. While this part of the work has its advantages in perfecting dexterity, it might be rightly claimed that too much time is consumed in reaching this goal that is not absolutely necessary in a professional way in actual engineering practice.

Time is at a premium in a four year engineering course and to meet this condition there is no manufacturing process subject that can be dispensed with without considerable detriment to the student in engineering. There are, however, methods that can be applied in presenting the various subjects that will greatly improve the work, thus allowing a greater field to be brought into consideration and an awakening of the visualizing and inventive qualities of the student thus rendering the work both entertaining and instructive.

A knowledge of the manufacturing processes and related sciences directly connected with any particular line of vocational work is exceedingly interesting and is of vital interest to the student in broadening his knowledge and tends to awaken a new sense of the subject as a whole. Fundamentals of manual operations are valuable but if treated as such alone are not at all interesting. Practical commercial problems requiring for solution a combination of the fundamentals of manual effort and associated sciences give the instructor interesting subjects not only for producing but also for class discussion.

A subject that is of considerable worth to the engineer when treated as applied in industry is that of Pattern Design, for either small or large production. In either case the design of the casting and arrangement of the pattern should be such as to facilitate the work to all concerned in which the making of the mold in the

foundry, also the machining of the piece in the machine department are involved. Further analysis of the part may show that the piece may be more economically produced in pressed steel necessitating the redesigning of the object. This naturally leads into the study of dies and presses, a subject of considerable interest and worth to the engineering student.

Having carefully considered the value of the training in actual manual work necessary to produce a pattern and the amount of time that will be consumed, if the student is required to produce with any degree of nicety, it appears that it would be expedient to sacrifice the making of the pattern and utilize the visualizing ability of students by substituting sketching and drawing to express ideas. Ability to do free hand sketching and instrument drawing are good assets to the engineer.

At the University of Illinois the work is carried on with the view of giving only that which may be of practical use in industry.

Pattern Design is the basis of our work and is demonstrated by the use of various types of patterns, core boxes and auxiliaries. Pattern Department management is treated with the thought of giving instruction in organizing such a department in a systematic manner to care for the large amount of detail usually involved.

We are using a text, "Pattern Design" that has been prepared solely for the purpose of giving the student only that which is important in the engineering profession in this phase of his work which assists greatly in carrying out this method of instruction.

It is often demonstrated in practice by drawings that have been submitted for a particular cast part that the designer has a very meagre conception of the processes involved in producing the piece. Faulty design, from a production standpoint, is a problem that is daily confronted in commerce causing considerable monetary loss. The designer being informed on the subject of manufacturing processes can greatly overcome this condition.

The work necessary to build a pattern skillfully requires considerable time. Manual work has its advantages when it is used to illustrate the different phases of patternmaking but the time of the engineering student can be used to better advantage by studying the design of patterns.

A Pattern Design is presented with the thought of familiarizing the student with the various ways and means of meeting the requirement with the least possible effort in producing the piece. By a careful study of these processes he is enabled to design a cast part in such a way as to facilitate the work to all concerned.

Casting design, pattern design and pattern construction are studied in a thoroughly practical way.

For pattern construction the student is given a problem that includes many different methods used in joinery by sketching the form of piece or pieces required to construct the pattern.

The next step is the study of the master pattern necessary to produce the metal working pattern, study also being given to the triple shrink pattern and its purpose explained.

The designing of metal pattern equipment is given extensive study including pattern plate, patterns, core boxes, core driers, core wire binding devices, core setting devices, etc.

Special problems are presented necessitating the designing of mechanical movements necessary in making a mold or a core thus reducing the work to a minimum.

There are many drawings of cast parts that may be simplified in design that present interesting and practical problems. A survey of blueprints or drawings used in industry will verify this statement and these furnish splendid problems as the student feels that his ingenuity is being put to a real practical test. Analyzing work of this character furnishes an opportunity for the student to display his initiative and develop his ingenuity and prove his aptitude for mechanical work.

The work is administered by supplying each student with a sheet of instructions explaining the necessary detail work. Problems of a very elementary nature but requiring careful study have been selected to introduce the student into the work. The ability of the student is quickly shown in devising ways and means of accomplishing desired results and a problem in keeping with his ability is given him for solution. In this method of instruction the alert student is not compelled to wait for those who are less fortunate.

The work is carried on entirely in the drafting room, free hand sketching and mechanical drawing, eliminating the manual work of constructing the patterns.

We find that the engineering students get four or five times the amount of technical knowledge and know more about general pattern work by this method of instruction than when they made the actual patterns in the laboratory.

A manual has been prepared treating on Pattern Design presenting the subject purely from the engineers' point of view.

THE COUNSELOR SYSTEM AT IOWA STATE COLLEGE

By LOWELL O. STEWART

Assistant Professor of Civil Engineering

Should a college treat its students with a sympathetic parental air, or should it assume that they are grown, sophisticated, and developed beyond the need of advice and counsel?

This has become a real problem. Prior to the World War colleges and universities were able to keep pace in faculty and physical equipment with the normal increase in enrollment. At present, however, the idea of universal education seems to be extending beyond the grammar and high school ages. The result is that each year finds larger numbers of young men and young women going on from high school to college or university with little or no knowledge or thought about the importance of the transition. Most of these young people are capable of carrying through a college course, but a very large number lack the purpose, aim, urge, and the "will to do" that is needed to set their intellects in motion. Naturally many become dissatisfied and unhappy, and as a result, make a sorry and discreditable showing. Others limp along through their studies content with a mere passing grade when they could, if their latent energies were set free and mobilized, become real leaders. Closely bound up with these are the numerous questions of finances, health, family conditions, sweethearts, and the like.

In the early days when enrollments were small it was possible for the college, through its deans and faculties, to maintain intimate and personal contact with each student. In fact, it was not uncommon to find at least one member of the faculty who knew every student on the campus. Those times have passed, but college authorities regret their passing and they are striving to set up simple, efficient, and economical machinery which will maintain that personal contact.

The plans, as well as the details, of this work have differed as the conditions and needs of individual institutions have differed. A few have set up comprehensive personnel systems with a trained personnel executive and competent assistants. At the other end of the scale are those who strove to obtain a little friendly contact with the students by assigning a few to each member of the faculty, who was to act as their adviser. Iowa State College used the latter scheme for several years until 1928 when President

Hughes planned and started the Counselor System which will be described in this paper.

Under the old system of advisers a small number of students, usually five or six, were assigned to each member of the faculty. These were kept within divisions so that an engineering student would go to a member of the engineering faculty, an agricultural student to a member of the agricultural faculty, a home economics student to a member of the home economics faculty, and so on. At the beginning of the fall quarter each member of the faculty would receive five or six pink cards, each of which gave the name, college address, and course of a student. The students received at about the same time similar individual cards telling them to call on Professor Smith, Professor Brown, or Professor Jones, at a certain room number in a certain building for help and advice.

Beyond this point the happenings depended upon chance, more or less. The faculty were busy and the students were shy. A young man might feel that he had done his part if he called and found the Professor's office locked, or the Professor might receive no reply to his request for an interview because the address was wrong. The result was that many of the students never did see their advisers while others made only a casual contact. There were a number, of course, who received much good from their more intimate associations with members of the faculty.

On the whole, the scheme was not a success. The reasons for its failure lay, not so much with the individuals, as with the principle. Several objections may be cited:

1. Many of these involuntary advisers were not qualified for and disliked such work.
2. The advisers had no administrative authority. They could report and recommend.
3. There seemed to be no particular aim or purpose in the interviews, beyond making out a time budget.
4. There was no checkup to see that the interviews were made.
5. There was no uniformity in the procedure or the requirements of the various advisers.

That scheme had failed to accomplish as much as had been hoped and the time was ripe for the counselor system, which President Hughes set up in 1928.

The people who became counselors were chosen because of their ability as teachers and their sympathetic attitude toward students. They became a part of the administrative system of the Junior College and were virtually deans over their respective groups of students. As such their word was very nearly final in all cases of policy, discipline, and the like, for the Dean of the Junior College,

Miss Roberts, held to the policy that the counselors should use their judgment and make decisions wherever possible.

Thirteen counselors were chosen in 1928. There were three from Agriculture, four from Engineering, three from Home Economics, two from Industrial Science, and one from Veterinary Medicine. Each of these counselors had charge of one hundred and fifty, or fewer, new students. In 1929 he continued in charge of his students who returned for the second year and added a new group of freshmen. Increased numbers made it necessary that a counselor be added in Engineering and in Home Economics so that in 1929 the number of students per counselor stood between one hundred fifty and two hundred.

Each counselor gave ten hours a week (in 1929, this became twelve hours) of scheduled time to the work. One of these hours was set aside for conferences with the Junior Dean or with other administrative officers. He spends his conference hours at individual desks in rooms arranged for his exclusive use. The counselors of a division have a common room, but conference hours are planned so that no more than two counselors will be in the room at one time, the thought being that the students will feel freer and more at ease if they have semi-privacy.

At the beginning of each quarter the students' class cards are marked with his counselor's name and the time at which the latter will be free to see him. The students are distributed as uniformly as possible amongst the counselor's scheduled hours to avoid unnecessary congestion. The student may, if he wishes, call on his counsel every week at his designated hour, and he may make special appointments. The essential point here is that there is an hour when the student may be sure that he will find his counselor. Naturally every man does not come in each week—if he did, a counselor could not possibly take care of two hundred men per week if he gave only eleven hours for that purpose. As a matter of fact the counselors do find it necessary to give additional time. Some men see their counselors often, sometimes to visit. Others come only when they have matters of importance, say three or four times during the quarter.

What do the counselor and the students talk about? Let us take them in order. All freshmen are required to see their counselor during the first two weeks of the fall quarter for the purpose of making a study budget. These study budgets are discussed at group meetings during Freshmen Week so that the student is familiar with the general idea. Every hour of the five and one-half day working week is allotted for study, classes, work, recreation, sleep, or other necessity, and so designated on the diagram.

Some of the students accept this as it is given, seriously; others feel that such a thing is beneath their notice as college students. However, at the end of the first six weeks all admit that it is needed.

After the completion of the time budgets, time is available for talking over special problems. The counselor now has time to look over the student's high school record and the results of the college psychological tests. Perhaps the individual snapshots are ready for his study. This must be done "between times" for there are many questions. This man is wondering whether he should study General instead of Civil Engineering; another has a limited amount of money and wishes to know whether he should borrow money or drop out of college for a while to earn some; another is having trouble with English and thinks that a tutor might help. At these interviews the counselor jots down notes about the man's appearance, habits, characteristics, and other important points that may be useful. Later he condenses and transfers these to regular personnel interview cards.

Progress reports, called mid-term grades, on each student's work are furnished the counselors through the Junior Dean's Office at the end of the first five weeks of every quarter. As soon as these grades are tabulated interviews are arranged promptly with every student who is making unsatisfactory progress. At that time the discussion is very frank regarding reasons for the poor showing. If the schedule is too heavy some is dropped; if the man has been lazy he is reminded of his obligation to make good; if he has been ill he is sent to the hospital for a special examination. Frequently, the student is asked to report his progress each week, which the counselor verifies by conferences with the boy's instructor.

During the last weeks of the quarter the counselor and student plan the latter's schedule for the succeeding quarter. For those who are making regular progress this is a simple and perfunctory procedure. A very large number soon become irregular because of entrance deficiencies, failures, lightened schedules for work or illness, and others. Each of these is a special problem. Some are making a poor scholastic record and are urged and required to carry a lightened schedule. Those who are earning a part of their expenses while in college are a problem for they, as a rule, wish to carry heavy schedules and do a large amount of work. All of this may be done after a fashion by a stenographer, but it can be done in a far more satisfactory manner by one who knows the students and the "ins and outs" of the course of study that he is following.

After the close of the quarter the Scholarship Committee reviews the records of those whose work seems unsatisfactory. At that time each counselor submits his list of names with all of the

data that he can assemble. He builds his case upon the opinions of other instructors as well as upon the observations that he has been making throughout the quarter. These opinions are returned on special cards that are sent to each instructor from the Junior Dean's Office.

The counselor appears before the Scholarship Committee in the role of a technical adviser. He sums up the results of all of his observations and, frequently, recommends the action which he thinks desirable. His intimate knowledge of the conditions that are influencing the student's progress makes him an invaluable aid during such deliberations.

A large portion of the counselor's time must be devoted to those who are making poor or slow progress. One of the most fascinating fields, however, includes those capable students who are working, palpably, below their ability. One learns from a study of such cases that the problem of education is complex and individual, and that a line of approach which is effective with one student may be useless with another.

The Counselor System is still new, but benefits and accomplishments seem to be emerging.

1. Misunderstandings between students and instructors are arising continually. While relatively small in themselves, they frequently lead to unhappy results. The students are prompt in bringing such matters to their counselor's attention. He is in a position to set things right in a short time.
2. In a like manner it has set up a general cleaning house to which any instructor can send information about students, which will receive prompt and sympathetic attention.
3. It is directing the attention of students to the need for a proper balance between work and play by helping them to budget their time.
4. It has helped men to find the course for which they are best fitted.
5. An attempt is being made to set right those capable students who are making poor records.
6. It has raised the percentage of good students who are retained in college and has hastened the withdrawal of those who are not of college caliber.
7. The counselor, having an intimate understanding of the work of the Senior College, has established better co-ordination between it and the Junior College.

THE "BOARD OF INQUIRY" VERSUS THE "LECTURE-RECITATION" METHOD OF EDUCATION

By EDWARD BENNETT

Professor of Electrical Engineering, University of Wisconsin

The Lecture-Recitation Method

The customary method of aiding students to obtain a grasp of any branch of organized knowledge, such as calculus or physics or electrodynamics, is to conduct classes of the *lecture-recitation* type in that subject.

The typical weekly schedule of classes in any one of these subjects may consist of one or more *lecture periods* and two or more *recitation periods*. The lectures are delivered to the entire group of from 50 to 300 or more students who may be pursuing the subject, but for the recitation periods the group is divided into *sections* of from 18 to 24 students each. In the recitation period the student recites on the work he is doing in the subject and has the opportunity to present his views and to bring about a discussion of obscure or difficult parts of the subject.

In the engineering classes in the fundamental subjects, in which there are excellent text-books, the more general practice is to dispense with the lectures and to use all the periods allotted to any subject for recitations. The class in any subject is divided into sections of 18 to 24 students each. In a fundamental subject like mathematics, the student will have five recitation periods per week, each 50 minutes in length. Of the 50 minutes available in each recitation period the instructor uses from 10 to 25 minutes in asking questions, calling attention to features of assignments, eliciting or giving explanations, etc., leaving, say, 35 minutes of the time in which the students may have the floor.

Weakness of the Lecture-Recitation Method

The weak feature of the recitation method of education is that in the typical class of 18 to 24 students, each student may be expected to have the privilege of the floor to exercise and develop his powers of oral expression and exposition in any subject not more than two minutes per recitation, or rarely as much as a total of 30 minutes per week in all the subjects of a full time program of studies.

The most frequently repeated critical comment on the preparation of the engineer grows out of the relatively poor showing which

the typical engineer makes when he is called upon to make an off-hand oral presentation of his views or of his position. Now the mathematical and physical sciences do not lend themselves to the same extent as do the historical and social sciences to free discussion and debate based upon the more common notions and experiences of mankind. Consequently a boy who elects to follow the engineering profession, as contrasted with one who elects to prepare for a career in the fields of law, or of economics, or of political or social science, by this very election, shows definite tendencies. He shows that he is predisposed to activities in which he is dealing with the not easily debatable principles of physical and mathematical science, rather than to the activities of the public forum. His studies in mathematical and physical science serve to confirm his natural tendencies, and undoubtedly the recitation method of education used in the engineering colleges is a powerful factor tending to stunt and repress any tendency toward free and ready oral expression.

In view of this situation, it would seem that an educational method should be used in the engineering colleges which will tend to modify beneficially the characteristics and influences sketched above. With this objective in view, a trial is proposed in one or more sections of certain fundamental engineering subjects of a method which will be called the *Board of Inquiry Method* of education. The features of the proposed Board of Inquiry Method are as follows.

THE BOARD OF INQUIRY METHOD

In the Board of Inquiry Method of instruction, the instructor divides his typical section of 18 to 24 students into three subgroups of 6 to 8 students each. These groups of 6 to 8 students will be called Boards of Inquiry. Each Board of Inquiry has available for its use at the hours formerly devoted to recitations a small room which is provided with some blackboard space, the necessary chairs, one or more conference tables, and for some purposes with models or demonstration equipment.

Each Board of Inquiry meets in its own room at the customary recitation period and proceeds to conduct an "inquiry" or a "hearing" on the topic from the text previously selected or assigned for that period. For the purpose of conducting the hearing on any topic, such as those suggested in the foot-note,[1] the

[1] The topics set for the hearings will be topics such as "Types of Motion," "Simple Machines," or "Force, Mass, and Acceleration" in Physics, or such as "The Notion of the Derivative," "Maxima and Minima," or "Derivatives of the Circular Functions" in Calculus, or such as "Electric Potential," "Properties of Conductors" or "Motional Electromotive Forces" in Electrodynamics.

Board at a prior meeting has apportioned to its members the following positions for the coming hearing.
Chairman.
Counsel for the Author's presentation or development.
Witnesses and experts for the Author's presentation—1 or more.
Counsel for the Defense Against Erroneous Views.
Witnesses and experts for the Defense—1 or more.

The hearings may be conducted after the manner of the hearings conducted by the Examiners of commissions such as the Interstate Commerce Commission, the Federal Radio Commission, or the Patent Office. The functions of the members participating in the hearing are as follows.

ORGANIZATION OF A BOARD OF INQUIRY OF 6 TO 8 MEMBERS

Chairman—Duties of:

A. To preside at the hearing and to see that the rules of orderly and considerate procedure are followed.

B. To pass upon questions of relevancy and irrelevancy.

C. At the end of the hearing to render a statement of the facts disclosed by the hearing.

Counsel for the Author's presentation, methods, line of development or interpretation.

Duties of Counsel:

A. To state briefly what he proposes to establish.

B. To elicit by questoning the Author's witnesses and experts—

(*a*) the experimental facts relating to the topic,

(*b*) the interpretation, or the correlating principles,

(*c*) illustrative examples bringing out the meaning of the principles or showing their applications.

Counsel for the League of Defense against erroneous or unfounded or hazy views.

Duties of Counsel:

A. To state briefly what he proposes to establish.

B. To elicit by the cross-examination of the Author's witnesses and experts, and by the direct examination of his own witnesses and experts, errors, uncertainties, ambiguities, inconsistencies, questionable reasoning, etc., in the case built up by the Counsel for the Aufhor, or by the Author himself, and occasionally to make a case for an alternative and equal or more effective development of the topic.

Witnesses and Experts.

The duties of witnesses and experts will be evident from the statement of the duties of Counsel. A system of knowledge which

has been gradually built up for the purpose of enabling men to get about in safety and in comfort amid the experiences of life, is to mastered. What are these *experiences,* and *what ways of regarding them* have been invented so that experience comes to be comprehensible and predictable as the result of the operation of a few natural laws? This is to be established by the testimony and demonstrations of the witnesses and experts. Witnesses or experts when not on the stand should sit with their counsel to confer with him and to render advice during the examination of the witness who is on the stand.

Reporter.

It is obvious that a record of the "Hearing" is not desired. It will undoubtedly happen, however, that Counsel or Witness will from time to time desire to ask the Chair that an "exception" to his "ruling" be noted. In this case, the Chairman may find it convenient to designate a *Reporter* to record the "ruling" and the "exception"; this record will be discussed and passed upon by the Instructor when he joins the group.

The organization of the Board may be changed daily or weekly, but preferably at the conclusion of the two or more hearings on each fairly brief, well-knit topic.

During the regular 50 minute period, the Instructor will have 15 minutes to sit with each board. He may sit with the chairman, or with either counsel, or may take the stand to testify for either counsel.

It will be seen that under this "Board of Inquiry" procedure, the time available for each student in which to exercise and develop his powers of oral expression is from five to ten times as great as in the recitation method. Moreover, the duties of each member of the Board are such that there is an incentive for him to be alert to everything which transpires, and to come to the meeting of the Board with the topic well organized. The incentive arises from the fact that he has the assurance of the opportunity to use and to test his observations and his knowledge.

The Spirit of the Hearings.

On first reading it may appear that the Board has been so constituted that the interests of the parties to the hearing are in conflict and that the "Hearings" may not rise above the low plane of a petty matching of wits, in which the sense of proportion and of common interest and common purpose is lost. On the contrary, it seems reasonable to expect that the holding of the Hearings in the study of the mathematical sciences will give the members, not

simply a vision, but a rich experience of the high plane upon which an inquiry may be conducted if the method of science is followed. To this end it must be emphasized that all parties to the hearing have a common objective, but that the attainment of the objective requires that the members play different rôles.

The common objective is the appreciation, appraisal and ultimate acquirement of new territory. The rôles which must be played at the hearings in the attainment of this objective have been separated and assigned to different individuals. But these rôles are identical with the rôles which each individual must play within himself. He must in turn and in the same general situation act as analyst, advocate, critic, and judge. Education consists in the balanced development of these powers and in the reconciliation of their demands.

The hearings must be conducted in the fine spirit of accommodation which, in the ardor to reach the heart of the matter, passes over the unimportant and the trivial in order to afford the time for valid criticism and real appreciation. For example, it is a triviality when a witness in the course of an explanation slips and says "right member of the equation," when from his actions it is obvious to all that he meant to say "left member." But it is not a triviality when in the course of developing new concepts, such as those of "electric potential" and "electric intensity," a witness uses the wrong name, or uses the name in a way to indicate erroneous ideas relative to it.

SHOULD ELECTRICAL MACHINE DESIGN BE A REQUIRED COURSE?

By LEONARD DOGGETT

Pennsylvania State College

From the early days when electrical engineering was the growing child of the physics department, through the period of adolescence and on into manhood, electrical machine design has received various degrees of emphasis. At first electrical machine design as a science was non-existent, and had to be built up by such men as Lamme in this country and Arnold in Europe. As the technology of electrical engineering grew in extent, one course after another was added to the electrical engineering curriculum. Eventually, it became top heavy with electrotechnical subjects. Careful selection of material then became necessary. In many a curriculum electrical machine design has now been reduced from a required to an elective course or even abandoned altogether.

And so the pendulum has swung; too far in the opinion of the author. Do electrical machine design courses have any raison d'etre? Should they be allowed to retire in the face of the modern strenuous competition for a place in the curriculum? The author believes that the omission of design courses is a distinct loss to any curriculum, the pruning away of important material for which there is no good substitute. It is pretty generally agreed among all parties now that design courses do not and should not try to produce designing engineers. On the other hand there are important viewpoints that may be had only by carrying through complete designs.

In the first place there is a general *philosophy* which runs through all design. There is no better way briefly of sketching out this philosophy than by exhibiting Table I. This table should in no way be looked upon as a complete picture but it does, however, sketch out some of the high lights. Our engineering graduates should go out with a sympathy and an appreciation for the problems of the designer. To cite an extreme case: an electrical engineer, familiar with electrical design, would hardly specifiy a 100,000 volt alternator, knowing that the stator slots would be so full of insulation that there would be no room at all for copper. Again, no graduate, trained in design, would try to specify a 10,000 Kilowatt, 1,000 R.P.M., Direct Current Generator, because of the impossibility of achieving successful commutation in such a machine.

In the second place there is in any design course the ever present *economic factor*. An excellent illustration of the influence of such

TABLE I.

ILLUSTRATING GENERAL PROCESS OF DESIGN

Specifications	D.C. Generator	Bridge	Aeroplane	Ship
	KW—R.P.M.—Volts at no Load and Full Load—Local Features such as Space Limitations—Operating Temperatures—Watertightness	Span—Width—Loading—Type Natural Features Such as Ice—Wind—Foundations	Maximum and Minimum Speed—Load—Endurance—Ceiling—Special Functions—Manoeuvrability	Carrying Capacity—Speed—Cruising Radius—Draft—Beam—Length—Cargo—Displacement
Experience Data from Similar Finished Products				
Limiting Factors	Heating—Commutation—Insulation—First Cost	Stability—Durability—Clearance Piers or Suspension—First Cost	Safety—Reliability—Supercharger—First Cost	Seaworthy—Operating Cost—First Cost
Activity Factors	Velocity—Flux Density—Current Density	Strength of Materials—Corrosion	Strength of Materials—Power Plant Weight per Horse Power	Space Allotment—Cargo Handling Equipment Strength of Materials
Preliminary Approximations	Drop in Armature and Series Field—Drop in Brushes—Shunt Current	Weight of Bridge	Weight of Power Plant—Wings—Landing Gear—Areas	Engine and Boiler Space—Spaces other than Cargo—Fuel Space
Starting Point	Armature	Trusses—Main Timbers	Wings	Hull
Design of Parts	When the parts are taken up in their proper sequence, each part as finished will in conjunction with the original specifications furnish specifications for the design of the next part. In the d.c. generator design, the design works radially outward.			
Final Check on Limiting Factors				
Final Calculation of Weights and Costs				
Final Calculation of	Efficiency—Characteristics	Factor of Safety for all possible Loads	Factor of Safety for all possible Loads	Metacentric Height—Draft Stability Rolling Period
Repetition of Design with [illegible]				

factors is furnished in the way designers choose distribution transformer current and flux densities with an eye to producing the maximum all-day efficiency. Further illustrations of the influence of cost factors are suggested by (1) Limited number of armature and frame diameters for a given line in machines; and (2) Standardized slot sizes and slot numbers. Illustrations without number might be cited of ways of reducing the amount of material needed and keeping down the production cost. Design courses are almost courses in production costs.

In the third place the design student is brought face to face with realities, *hard realities.* Four square inches of copper have to be squeezed into three square inches of space. What to do? The finished machine has too low an efficiency. What to do? The finished product costs too much. What to do? Conflicting pressures are brought to bear on the commercial designer, pressure from the sales force to produce the cheapest machine; pressure from the test force to keep the machine operating satisfactorily. Space limitations, called for in railway or marine practice; speed limitations set up by connected loads; always some inescapable physical facts to be considered in the design. In elementary class room problems a straight line saturation curve is ordinarily assumed for the sake of simplicity. As a matter of fact the saturation curve is not at all straight, and in the design room the saturation curve is accurately dealt with since it is the dominating factor in the design of any electrical machine. A design course is one place where the "whys" and "wherefores" are not sidestepped because of a lack of time.

Perhaps the ideas of the two previous paragraphs might better be summed up under the title of *engineering judgment.* In engineering practice the engineer is always faced by a set of cold physical facts and a group of commercial facts. By the use of his judgment he produces a finished product which gives due weight to all important factors.

Numerical accuracy in calculation is a prerequisite in engineering practice of any sort. Design students usually start off with the happy idea: "What are a few decimal points among friends?" The student is soon disillusioned for at very frequent intervals the results of his calculations are brought into comparison with normal values, and any great deviation from normal calls for a check. Thus design is one of the few courses where accuracy becomes of paramount importance.

Construction details are best studied in the design room. There, pictures, cross sections, and actual samples of detail parts may be exhibited. Armature winding is much more easily taught in the design room than in the class room. Design is the subject where

TABLE II

Data on the Design of a Line of Twelve Alternators

All Machines 1800 R.P.M.—60 Cycle—13,200 Volts—3 Phase

Name of Designer	Name of Customer	Independ. Variable KVA.	(Diam.)² × Length	Diam. Inches	Approx. Length Inches	Number Stator Conductors	Number Stator Slots	Turns Per Phase	Stator Current Density	Actual Amp. Cond. Per Inch	Final Length Inches	Watts Per Sq. Inch Stator Coils	Flux Per Pole in Million Line	Field Currents at Full Load and 100% P.F.	Field Currents at Full Load and 80% P.F.
N. Green	Newport News Gas & Elec. Co.	10,000	95,500	45	47	432	72	72	1700	1470	45	.32	39	194	241
F. L. Pope	Boston Edison	15,000	135,000	45	66	288	72	48	1175	1470	76	.348	58	289	306
T. C. Martin	Milwaukee Elec. Rwy. & Light	20,000	168,000	45	84	240	60	40	1870	1680	79	High .595	78	245	325
E. Weston	Middle West Utilities	25,000	209,000	48	91	192	48	32	1390	1700	90	.467	91	323	430
E. Thomson	Metropolitan Edison	27,500	229,000	48	100	168	84	28	1460	1580	120	.41	120	334	440
W. A. Anthony	Kansas City Power & Light	30,000	251,000	48	109	168	84	28	1600	1375	126	.387	111	414	478
A. G. Bell	New York Edison	33,000	290,000	50	116	144	72	24	1885	1460	122	.523	121	425	545
F. J. Sprague	Galveston—Houston Elec.	35,000	301,000	50	121	144	72	24	1760	1550	121	Low .125	130	440	578
E. J. Houston	Conn. Light and Power	40,000	334,000	52	124	144	72	24	1700	1695	129	.466	130	440	585
L. Duncan	Penna. Power and Light	44,000	394,000	52	145	120	60	20	1425	1560	138	.403	157	453	540
F. B. Crocker	Phila. Elec.	50,000	438,000	52	163	120	60	20	1780	1760	152	.40	157	520	620
A. E. Kennelly	Brooklyn Edison	65,000	500,000	52	188	Two path 144	72	12	1400	1450	248	.34	260	920	1080

a student may take a bare idea and convert it into something tangible, translate it into dimensions, thus inevitably developing his technical imagination.

Hardly a course in the curriculum could duplicate these advantageous features. In spite of all this, design courses have been decreasing in number and importance throughout American technical schools. Perhaps the difficulties in teaching the subject may account for this to some extent. One of the bugaboos of a design course from the point of view of the instructor is the necessity of checking a multitude of student calculations. A method of reducing this task to a trivial one is suggested by Table II. Here, in the design of a line of twelve alternators, all the specifications save one, the KVA, are made the same. A table, similar to that shown in Table II, is mounted on a drawing board. At each design period each student enters the results of his day's computations. As a rule the entries are either a continuous function of the independent variable or constants that vary within certain small well known limits. A glance down the columns will indicate any anomalous values and call for a check of the calculations by the individual student. This method automatically eliminates the majority of numerical errors and ensures that the finished machine is not a strangely abnormal machine, the product of many a spurious "two" and "ten."

By saving tables of this type from year to year the design office comes into the possession of experience data; such data are always available in a commercial design office, but woefully lacking in college design offices.

The table shown in Table II is an abbreviation of the actual table which has some 40 to 50 columns for 20 to 30 machines. Although abbreviated, it illustrates the principal features of the method. By tabulating customer's names an added touch of reality is obtained. It may be noted that the number of available diameters is limited to four for economic reasons. An alert student, keeping watch of such a table, will gain experience on a whole line of machines, while at the same time he has but one machine to design completely.

In conclusion it may be well to repeat that the design point of view is extremely worth while getting, for the reasons already cited. A design course can be taught with a reasonable demand on the time of the instructor and yet at the same time no major numerical errors escape notice.

NEW MEMBERS

BIVINS, CHALFANT E., Instructor in Chemistry, Pratt Institute, Brooklyn, N. Y. S. S. Edmands, Allen Rogers.

BROWN, CARROL G., Division Head, General Engineering Laboratory, General Electric Company, Scotia, N. Y. M. M. Boring, L. H. Means.

DEGLER, HOWARD E., Professor and Chairman, Department of Mechanical Engineering, University of Texas, Austin, Tex. Alex Vallance, Carl Eckhardt, Jr.

GUERIN, FREDERICK J., Instructor in Chemistry, University of Maine, Orono, Maine. I. H. Prageman, W. S. Evans.

HAMMOND, ROBERT J., Instructor in Drawing and Architecture, University of Arkansas, Fayetteville, Ark. W. R. Spencer, C. L. Farrar.

HOLMES, ALESTER, G., JR., Instructor in Mechanical Engineering, University of Arkansas, Fayetteville, Ark. M. E. Farris, A. S. Brown.

HOSFORD, H. M., Professor of Mathematics, University of Arkansas, Fayetteville, Ark. W. N. Gladson, G. P. Stocker.

JOHNSON, ERNEST E., Industrial Managerial, Engineering General Department, General Electric Company, Schenectady, N. Y. M. M. Boring, George H. Pfeif.

KIMBALL, ALLEN H., Professor and Head, Department of Architectural Engineering, Iowa State College, Ames, Iowa. T. R. Agg, A. H. Fuller.

LLOYD, DANIEL B., Instructor in Applied Mathematics, Syracuse University, Syracuse, N. Y. S. T. Hart, H. W. Blackburn.

MAGOUN, F. ALEXANDER, Associate Professor of Humanics, Massachusetts Institute of Technology, Cambridge, Mass. H. L. Davis, R. I. Rees.

MICHEL, RUDOLPH, Assistant to Director, Cooperative Work, University of Pittsburgh, Pittsburgh, Pa. E. Willis Whited, E. A. Holbrook.

NESBITT, RICHARD E., Instructor in Foundry Practice, Pratt Institute, Brooklyn, N. Y. S. S. Edmands, John W. Burley.

NICHOLS, BEN H., Instructor in Electrical Engineering, Oregon Agricultural College, Corvallis, Ore. R. H. Dearborn, L. F. Wooster.

STEVENSON, ALEXANDER, R., JR., Staff Assistant to Vice President in charge of Engineering, General Electric Company, Schenectady, N. Y. George H. Pfeif, M. M. Boring.

SWARTZ, BLAIR K., Fellow in Personnel Administration, University of Michigan; Research Associate, Employment Bureau, The Detroit Edison Company, Detroit, Mich. A. D. Moore, Benj. F. Bailey.

EDUCATION FOR ANALYSIS IN THE COOPERATIVE PLAN

By ROBERT C. DISQUE

Drexel Institute

It is often assumed that the principal advantages of cooperative engineering education, if not all of them, pertain to the practical knowledge gained in industrial work; and that, therefore, the cooperative plan may be expected to prepare effectively for executive and supervisory positions, but less effectively for positions involving analysis and design. But an experience of twelve years in cooperative education convinces the writer that this assumption, so far as it pertains to analysis, is far from being justified. In fact, there is much evidence to indicate that interest in purely analytical work is stimulated and proficiency therein promoted by the industrial experience inherent in a carefully designed cooperative curriculum.

There are two reasons for this conviction. The first has to do with the refreshing effect of the alternate periods of practical work. When a student arrives at the second year of his college course, he has upwards of fourteen years of almost continuous study behind him—years crowded with intellectual effort. Probably he will not experience another equal period so strenuous, even in his later professional life. The result is a tendency toward staleness—a condition easily recognized as one of the chief causes of the enormous number of failures in the first few years at college. Many students who do well in analytical subjects in high school come, after a short period of college pressure, to resemble an overtrained athlete. Those who drop their college work to take positions in industry or business under these conditions are too likely never to return to their studies; the sacrifice of an apparent opportunity to advance in the outside job seems too great. Some, accepting their decision as final, marry and thus undertake responsibilities impossible to avoid, even temporarily.

This condition is not helped by repetition of courses once taken and failed. What is needed is a brief interim of contact with work of a different nature, subordinated to the student's ultimate motive. By providing an interval of mental relaxation without sacrificing continuity of interest, the cooperative plan avoids the dangers of overtraining. The industrial job is accepted as a necessary part of the whole training period and not as an embarkation upon a

definite career. Renewed interest and vigor are thus brought back to the college work and the crisis is likely to be passed.

But there is also a direct stimulus to theoretical work, especially in the cases of students initially inclined toward analysis. There is nothing like a period of contact with engineering to teach a student the value of knowing, for it is in this contact that he sees most clearly the difference between the trained and untrained mind, in dignity as well as economic value. The theoretical studies in college profit greatly by this experience. Any doubts about the value of theoretical work, and about the authority of the professor teaching such work tend to disappear, and in their place come renewed faith and restored confidence. This is a mighty help to the teacher of theoretical subjects. Students thus refreshed and stimulated, can be led on all sorts of adventures into the highly theoretical reaches of their subjects, if the teacher's enthusiasm and equipment carry any conviction at all. And so there need be no misgiving about the power of the cooperative plan to attract students equipped with analytical minds, and to stimulate and train them for analysis and design.

A CLEARING HOUSE FOR MACHINE DESIGN DATA

Teachers of Machine Design in colleges and technical schools have formed a "Clearing House" the purpose of which is to exchange problems in machine design, research data, ideas as to methods of teaching machine design, and other information of mutual interest. Material contributed by the members is sent to the S. P. E. E. Chairman, Professor Frank L. Eidmann, Columbia University, New York City, and mimeographed copies are distributed to the members.

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

The mast head: Hereafter the "T-Square Page" will be distinguished by a mast head built around the "Arms of the Guild of Drawers." The designer, Professor Thomas E. French says of it: "The blazonry would read: Argent, on a fess sable three triangles of the first. In chief two planes rampant combatant, and in base two pencils in saltire. Crest, on a wreath of the colors a T-square palewise proper. Motto, Gaspard et les droites."

"The study of fundamental spatial relations, whether between abstract points, lines and planes, or their concrete manifestation as beams and columns, shaft of pipe-lines, pulley, plates, roof-members, sheet metal forms, etc., gives the student a camera-like insight that is not to be discounted nor discouraged; but it is far more important that he learn to make this insight function in an active and constructive manner—which means simply that he learn to think. Now, since the attainment of the ability to think clearly can be indicated to the instructor only by the manner of expression used by the student, it is evident that outwardly and practically the aim becomes the development of good expression. This has reference both to the oral and graphic responses."—Prof. F. M. Porter.

Problems in Descriptive Geometry:

Given two non-intersecting, non-parallel lines, AB and CD and a place S. It is required to determine a line MN which shall terminate in AB and CD and satisfy one at a time the following additional conditions:

1. Be parallel to plane S and of specified length L.
2. Be parallel to plane S and of shortest possible length.
3. Be inclined to plane S a specified angle θ, and of specified length L.
4. Be inclined to plane S a specified angle θ, and of shortest length possible.
5. Be inclined to AB a specified angle ϕ, and of specified length L.
6. Be inclined to AB a specified angle ϕ, and of shortest length possible.

---

7. Given any triangle ABC. Construct a pyramid M-ABC such that the lateral edges MA, MB and MC are of specified inclinations α, β and γ respectively to the plane of the base ABC.

---

8. Four horizontal lines taken at random are the horizontal and vertical traces of a plane T and the horizontal and vertical projections of a line AB. Locate the ground line so that the line AB is contained in the plane T. —Suggested by Prof. F. M. Porter.

". . . Descriptive geometry has held its place in the engineering curriculum for a century and a half, and while it has yielded time for other purposes, under the constant pressure of an expanding scheme of studies, there has been remarkably little questioning of its grounds for inclusion. Engineering educators have been disposed to grant its claims to value as a rigorous intellectual exercise, as a means of developing and organizing the student's powers of visualization, and as a discipline in precise representation of spatial relations. Language and ideas have very intimate relations; grammar is more than a body of conventions, it is in fact the logic of language. The same principles hold for the language and ideas of space and form, and descriptive geometry has seemed to rest secure on its premises as the grammar of spatial representation." PRES. WILLIAM E. WICKENDEN.

THE CONTENT OF AN ENGINEERING DRAWING COURSE

By H. M. McCULLY

Carnegie Institute of Technology

The recent summer school, with its highly concentrated program, was so pregnant with prospects for enlarged usefulness for the graphic subjects that I have a sincere feeling that the restrictive influences which were factors in the selection and set-up of course content for Engineering Drawing have been largely dissipated. The papers of Professor Hammond, President Wickenden, and Dean Sackett may be said to indicate clearly, in the aggregate, the general contribution that administrative personnel hope may eventually be realized through proper content. But these papers present only a prospect, hardly a fixed program. Realization of the varied aspects there suggested would depend upon the proper content. I venture the prediction that many of our able departmental executives could readily write an idealistic program that would meet the requirements of such a prospect. It is possible, as has been done by the members of the Division's Committee on Engineering Drawing, to reduce the minutae of such course content to a smoothly flowing sequence of exercises intended to develop to a maximum the blended skill and information which is demanded of Engineering Drawing courses as an essential and prerequisite part of engineering curricula. This content could quite readily be correlated to the suggested objectives, but under no conditions should it be thought that such procedure is needed to vitalize and justify drawing and descriptive geometry as engineering education material.

But, as the writer pointed out in discussing this matter before the conference, these paper set-ups almost wholly ignore the very vital, human elements of the men who teach, and those who are taught. It ignores tendencies, which become more and more obvious with experience, to make every subject sufficiently flexible to meet the rapidly changing condition of modern engineering development.

. . . In engineering practice it is no longer sufficient that a structure or a machine satisfy the requirements of technical formulae. This, of course, will always be prerequisite. But the world today demands that engineering achievement shall catch and express in permanent form the emotional inspiration that lies behind great planning and great doing. Our public today demands

not only the comfort of service which comes from completed engineering projects, but asks for a reflected part of the thrill of their creation. Some call it Art in Engineering. We must comply with this demand to achieve the full share of recognition to which the engineering professions are entitled.

Engineering education can never be otherwise than an integral part of engineering practice. Course content can no more be restricted to formula than achievement will satisfy on the basis of formula only. A group of students, filled with the desire to build magnificently, to create splendidly, filled with the surging desire of youth to go forth and conquer, not dragons or giants or tyrants, but the last challenges of recalcitrant nature, or to discover unknown principles which will increase human happiness, will not be satisfied with a course content which, though perfectly coordinated, yet does not give engineering education an opportunity to display the art of inspirational development. The meticulous drill elements will be gladly endured if the content affords and creates an opportunity for expression, at least between teacher and student, of those things which the student longs to do. Such things will rarely, if ever, come to the surface in mass contact, and course content which is based upon mass teaching alone will not then, I believe, afford an opportunity for this major requirement of our teaching.

Nothing so tends to fix idealism as a component of character as opportunity to express and discuss that idealism with others. In effect, the process becomes a pledge. I feel that if, in beginning courses with young engineers, their consuming enthusiasms can thus early be caught, even in the ephemeral permanence of fleeting words, they will thereby be more deeply and more indelibly impressed in the character of the engineer; and that character will show through every achievement of his later life. . . . And this is the form that the art of the engineering teacher should take, and which, clearly limned, will show against the background of every engineering drawing course.

Course content is not merely a set of sequential exercises so much as it is a conscientious, punctual day by day performance of duties by student and teacher—conscientious, carefully reasoned answers to a prepared problem, and those answers carefully checked.

But repetition of course content year by year breeds monotony —and monotony dulls even the edge of emotional inspiration. No personal contact between two persons can long continue on a plane of enthusiasm where only one party is enthusiastic and interested. It is essential that, somewhere in our set-up of drawing work, some

source of continued interest be provided for the teacher which will match the native enthusiasm of the student.

Mozart in all probability practiced the musical scale faithfully even in his later life but largely because he was weaving its elements into undying symphonies. Rembrandt probably made experimental mixtures of pigments as a preparation for his masterpieces, and I think most drawing teachers would gladly continue to produce excellent teaching results in the elemental drill problems if their departmental organization were such as to include some advanced courses in which they may employ such elements to produce material that satisfied their own wish for expression. There are many courses almost, if not entirely, graphic in their nature which might be given by drawing teachers to satisfy this longing. It must be obvious that to restrain the efforts of a good drawing teacher to the mere finger twitching exercises, while others have the privilege of making the application to the advanced drawing, can only be depressing to him. This depression is soon reflected in the work of the student and the idealism for both is sacrificed to a difficulty readily remedied. These broader courses are in many cases what might be termed "low-level courses" for departments having students in charge. They are frequently used as schedule fillers and lack vitality under these circumstances. This might easily be gained by placing them in a service department where they become a major interest to some instructor.

COLLEGE NOTES

Northeastern University.—Two new buildings have recently been added to the Northeastern University Athletic Plant. One of these, a baseball cage, is located on the site of the University on Huntington Avenue, Boston, and the other, a large new field house, is situated at the University's athletic field in Brookline within two miles of the University.

The administration is greatly pleased by the fact that throughout the industrial depression that has prevailed for some time, the number of companies cooperating with the University has remained practically constant. In some cases the number of students employed by a single company has been somewhat diminished because of business conditions but in relatively few cases have employers found it necessary to discontinue the plan altogether. This indication on the part of employers of their confidence in the soundness of the cooperative plan has been reflected in the wholesome attitude with which the students have faced problems engendered by the economic depression.

The Department of Cooperative Work now comprises eight coordinators who give their full time to the counseling and placement of students and to the maintenance of appropriate relationships with cooperating companies. Two of these coordinators are engaged in the development of cooperative programs for Business Administration students; the others are affiliated with the several engineering curriculums.

The past year has seen considerable refinement of detail in the freshman orientation and guidance program. A Dean of Students assisted by a corps of faculty advisors and a full-time clinical psychologist supervises the new program of freshman work. Problem cases are sorted out early in the freshman year and those who need special diagnosis and remedial treatment are handled individually. Professor Stanley G. Estes, a psychologist of several years' experience in psychiatric measurement with the Judge Baker Foundation in Boston, gives his full time to the University and has charge of this phase of the freshman guidance program. It is expected that the organization for guidance as now set up will not only decrease the mortality in the freshman year but will also enable the giving of helpful counsel to those students whom it seems necessary to drop because of their inability to profit by the programs of study available at Northeastern.

The Tulane University of Louisiana.—Some eighteen years ago the need of field practice in surveying was met by Tulane in the establishment of a Camp of Survey Practice. This was made possible through the kindness of the late Mrs. I. G. Gayden of Oakland Plantation, East Feliciana Parish in this state. Since 1913 attendance at the camp by students of civil engineering at the close of their Sophomore and Junior years has been a requirement.

This modern camp, under the direction of instructors with experience gained from service in the U. S. Coast and Geodetic Survey, the Alaska Boundary Survey, state highway, municipal railroad and commercial surveys, is well known. Some of its features have been considered by other schools contemplating the establishment of something similar. There is nothing new in the idea of a camp of survey practice, civil engineering schools of the better sort have had them for many years. Perhaps we have been more fortunate in the facilities which we have enjoyed and which we feel have contributed much of value to the student's training.

BOOK REVIEW

"Elementary Electricity." By ASSISTANT PROFESSOR E. P. SLACK, Polytechnic Institute of Brooklyn. Published by McGraw-Hill. Price $2.00.

The author has divided this book into ten chapters which include the subjects of direct-current circuits; current; resistance; voltage; D.C. generators; D.C. Motors; Energy and power in D.C. circuits; Alternating currents; Distribution systems and Polyphase apparatus; and the last chapter Vacuum tubes and Radio Reception.

At the close of each chapter is tabulated a list of questions which tend to emphasize the most important principles outlined in the chapter.

The book is non-mathematical. It is very clearly and plainly written so that the beginner may surely understand it easily.

There are some two hundred illustrations including a few photos. The appendix includes instructions for resuscitation by the Prone pressure method.

The book should find application in vocational and industrial schools, among students who have not studied electricity before and whose mathematical training may not have gone beyond arithmetic.

R. C. G.

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REPORT OF 1930 SURVEY OF ENGINEERING EDUCATION *

F. L. BISHOP, *Secretary*

Society for the Promotion of Engineering Education

The object of this survey was to secure a measure of the progress which had been made in engineering education in each institution. The data were compiled from answers to questionnaires sent out by the Office of Education, Department of Interior, Washington, D. C., January, 1930. Questionnaires were sent to those institutions which had taken part in the investigation conducted by the Society for the Promotion of Engineering Education through its Board of Investigation and Coördination.

QUESTIONNAIRE SENT JANUARY, 1930

Data in Connection with Studies of Engineering Education, January, 1930

The following request for information is being sent to institutions which took part in the investigation conducted by the Society through its Board of Investigation and Coördination. The object of this is to secure a measure of the progress which is being made in engineering education in each institution.—Editor.

INFORMATION FOR THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

Institution_____

Institutional Representative_____

Note:—Blank pages will permit amplification of answers if space provided is insufficient.

* We acknowledge with appreciation the valuable coöperation of Commissioner of Education, Wm. J. Cooper, Dr. Walton C. John, General R. I. Rees, and Mr. Ovid W. Eshbach.

PART I

ADMINISTRATION

1. Undergraduate enrollment in Engineering, Dec. 31, 1929.

	E. E.	M. E.	C. E.	CH. E.	E. M.	I. E.			TOTAL
FRESHMEN									
SOPHOMORE									
JUNIOR									
SENIOR									
SPECIAL STUDENTS									
TOTAL									

NOTE: INCLUDE DAY COURSE ENROLLMENTS ONLY.

									TOTAL
FRESHMEN									
SOPHOMORE									
JUNIOR									
SENIOR									
SPECIAL STUDENTS									
TOTAL									

NOTE: INCLUDE DAY COURSE ENROLLMENTS ONLY.

2. Enrollment of Graduate Students in day courses, Dec. 31, 1929.

	FOR ENGR. DEGREE	FOR M. S.	FOR PH. D.	TOTAL
ENGINEERING				
PHYSICS				
CHEMISTRY				

NOTE: WHERE THE ABOVE FORM IS UNSUITED TABULATE ON SEPARATE SHEET.

3. If evening courses in collegiate engineering subjects are offered give total enrollment, Dec. 31, 1929.
   Number receiving credit toward bachelor degree.....
   Number receiving credit toward graduate degree.....
   Number of students not candidates for degree.....

4. Fees for undergraduate courses. (If different for non-residents of the state, so indicate.)
   (a) Tuition for Engineering Courses.....
   (b) Tuition for Other Courses.....
   (c) Additional charges per year, including laboratory fees, etc., for Engineering Courses.....

5. Cost per Engineering Student per year. (Include only if estimate has been previously made):—
   Remarks as to basis of calculation:.....

6. Administrative Officers and Teachers of Engineering Students.

	NUMBER	SALARY		
		MAXIMUM	AVERAGE	MINIMUM
ADMINISTRATIVE OFFICERS (Incl. Dean)				
DEPARTMENT HEADS				
PROFESSORS				
ASSOCIATE PROFESSORS				
ASSISTANT PROFESSORS				
INSTRUCTORS				
ASSISTANTS				
* OTHERS				

* NOTE: PLEASE SPECIFY.

7. Approximate investment in laboratory equipment used for instruction in engineering.
8. General Remarks on Part I.....

PART II

STUDENT SELECTION AND EDUCATIONAL GUIDANCE

1. Contacts with Secondary Schools.
   (a) If systematically maintained please state nature of these contacts.....
   .....
   (b) Have these contacts resulted in improvements in quality and fitness of matriculants, or in other desirable results?.....
2. What is your process of selection of Freshmen?.....
3. Admissions.
   (a) Total number of Freshmen admitted this year, up to Dec. 31, 1929
   .....
   (b) Number admitted with conditions.....
   (c) Number of Students admitted to advanced standing.....
      1. From other Engineering Schools.....
      2. From other Collegiate Schools.....
      3. Transfers from other courses in your institution.....
   (d) Number of Freshmen who have failed to present required units in the following subjects:

	UNITS REQUIRED	NUMBER FAILING TO PRESENT REQUIRED UNITS
ALGEBRA		
SOLID GEOMETRY		
TRIGONOMETRY		
PHYSICS		
CHEMISTRY		

4. Educational Guidance and Orientation of Freshmen.
   (a) If one or more of the following methods are used please indicate by a check mark.
   ....." Freshmen Week "—Number of days.....
   .....Engineering Problems Course.
   .....Required Orientation Lectures.
   .....Series of unrequired talks or lectures.
   .....Faculty advisers.
   (b) Other methods.....

5. Eliminations.

(a) From the original group of Freshmen:—

	CLASS BEGINNING IN FALL OF:		
	1923	1924	1925
NUMBER OF FRESHMEN ADMITTED			
NUMBER REMAINING AFTER 1 YEAR			
NUMBER REMAINING AFTER 2 YEARS			
NUMBER REMAINING AFTER 3 YEARS			
NUMBER GRADUATING IN 4 YEARS			
NUMBER GRADUATING IN 5 YEARS			
NUMBER STILL IN COLLEGE			

(b) Please tabulate below the total enrollment at the beginning of the school years indicated.

FRESHMEN	1923 ———	1924 ———	1925 ———
SOPHOMORES	1924 ———	1925 ———	1926 ———
JUNIORS	1925 ———	1926 ———	1927 ———
SENIORS	1926 ———	1927 ———	1928 ———
NUMBER GRADUATING	1927 ———	1928 ———	1929 ———

6. (a) Do the college records indicate the causes for eliminations.....

(b) If any analysis of causes for eliminations has been made please state result.....

7. General Remarks on Part II.....

PART III

COURSES AND CURRICULA

1. Please state the number of semester hours credit required for graduation.

	E. E.	M. E.	C. E.	CH. E.	E. M.	I. E.		
MATHEMATICS								
PHYSICAL SCIENCE								
ENGLISH								
MODERN FOREIGN LANGUAGES								
ECONOMICS								
TECHNOLOGICAL SUBJECTS,								
MAJOR BRANCH								
OTHER TECHNICAL SUBJECTS								
SHOP								
DRAWING								
ELECTIVES								
PHYSICAL & MILITARY EDUCATION								
TOTAL								

MATHEMATICS								
PHYSICAL SCIENCE								
ENGLISH								
MODERN FOREIGN LANGUAGES								
ECONOMICS								
TECHNOLOGICAL SUBJECTS, MAJOR BRANCH								
OTHER TECHNICAL SUBJECTS								
SHOP								
DRAWING								
ELECTIVES								
PHYSICAL & MILITARY EDUCATION								
TOTAL								

2. What significant changes in educational policy or curricula have taken place in the last five years.

3. What significant changes have taken place in the last five years regarding the number and quality of graduate courses.....

4. Where is the administrative control of graduate work placed and how is it supervised?

5. General Remarks on Part III.....

PART IV

EDUCATIONAL DEVELOPMENT

1. Have any significant changes been made in teaching methods, and if so give particulars.....

2. Have any experiments in teaching methods been conducted? If so, give particulars.....

3. Normal teaching load of Engineering Teachers expressed in total clock hours (class periods of fifty to fifty-five minutes each) per week in actual contact with students in class or laboratory.

	Hours per Week
Department Heads	
Professors	
Associate Professors	
Assistant Professors	
Instructors	
Others	

4. Research and Publications.
   (a) Number of Research Fellowships.....
   (b) Number of part and full time assistants devoting time to research.....
   (c) Number of published bulletins or monographs on research exclusive of articles in periodicals, except where reprinted. (Within the last five years).....
   (d) Total expenditures for research, 1928–1929 (if available).....

5. S.P.E.E. Summer Schools.
   (a) Has your institution defrayed any of the expenses of the representative to these schools?
   (b) What is your impression as to the values received by those who have attended?.....

6. General Remarks on Part IV.....

PART V

GRADUATE PLACEMENT AND DEMAND

1. Methods employed in placement of seniors.
   (a) If one or more of the following methods are used, please check.
   .....Personnel or Placement Officer.
   .....Dean of Men or similar Administrative Officer.
   .....Department Heads.
   (b) Give brief statement the type of records kept for placements purposes
   .....

2. How is information of employment opportunities conveyed to seniors and undergraduates?

3. Opportunities for Engineering Graduates.
   Please give what information you have under the following:—
   (a) Number of Senior Engineering Students, 1929 .....
   (b) Number of Industries visiting campus, 1929 .....
   (c) Number of contacts through correspondence or other means .....
   (d) Number of positions offered. .....

4. From what information is available, please list below the number of positions accepted at the different initial starting salaries.

MONTHLY RATE	NUMBER OF POSITIONS

5. If any studies of salary progress of graduates have been made in the last five years, list them. Please include the results of the studies.

6. General Remarks on Part V.....

REPORT OF 1930 SURVEY OF ENGINEERING EDUCATION

Part 1. Enrollments and Factors Affecting Enrollment

- *a.* Eliminations in College
- *b.* Selection Methods
- *c.* Orientation Methods
- *d.* Secondary School Contacts
- *e.* Tuition

Part 2. Standards of Education

- *a.* Entrance Requirements
- *b.* Curricula Requirements

c. Improvement in Methods
d. Graduate Study
e. Research
f. S. P. E. E. Summer Schools

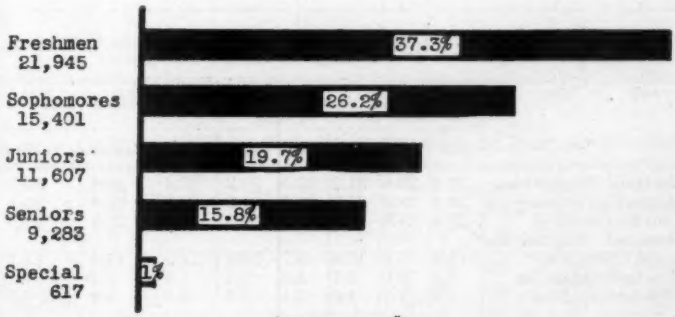
Part 3. Administration
a. Salaries
b. Teaching Load
c. Personnel Systems

ENROLLMENTS AND FACTORS AFFECTING ENROLLMENTS *

1. Total Undergraduate Engineering Enrollment December 31, 1929

(For comparative enrollment see Vol. XVIII, No. 10, Page 951, Journal of Engineering Education)

Distribution by Classes in 119 Institutions ..... 58,853 Students
Probable Enrollment in 145 Institutions 70,000



Admissions *

Data From 83 Institutions

(*a*) Number of Freshmen admitted in 1929	17,840
(*b*) Number of Freshmen admitted with conditions	3,041
(*c*) Students admitted to advanced standing	2,618
1. From other Engineering Schools	601
2. From other collegiate schools	1,714
3. Transfers from other courses	303

* Page 221, Vol. I, Final Report of Investigation of Engineering Education.

2. PERCENTAGE DISTRIBUTION OF CLASS ENROLLMENTS BY ENGINEERING COURSES
December 31, 1929

	Class			
	Senior	Junior	Sophomore	Freshmen
Electrical Engineering	29.8	29.0	26.2	27.9
Mechanical Engineering	19.1	20.5	22.6	22.7
Civil Engineering	25.1	23.9	20.6	19.5
Chemical Engineering and Chemistry	11.0	11.2	13.2	13.1
Mining Engineering	1.3	1.4	1.9	1.7
Industrial, Administrative and Commercial Engineering	4.0	3.6	2.9	1.4
Architectural Engineering	3.4	4.0	4.1	4.4
Aeronautical Engineering	2.0	1.7	3.3	2.9
Metallurgy	.8	1.8	.8	.7
Other	3.5	2.9	4.4	5.7
Total	100.0	100.0	100.0	100.0
Number of Students	6,267	7,852	10,007	10,418
Number of Institutions	75	74	65	43

3. PERCENTAGE DISTRIBUTION OF ENROLLMENT IN SIX MAJOR COURSES

	First Degrees Conferred				Enrollments Dec. 31, 1929			
	1922	1924	1926	1928	Senior	Junior	Sophomore	Freshmen
Electrical Engineering	23.5	28.2	31.2	35.5	33.3	32.2	29.6	31.3
Mechanical Engineering	26.4	28.3	25.2	22.5	21.2	22.6	25.4	25.4
Civil Engineering	25.4	24.0	26.0	26.0	28.0	26.7	23.3	21.9
Chemical Engineering and Chemistry	15.9	11.5	10.3	9.7	12.3	12.5	15.0	14.7
Mining Engineering	7.3	6.9	5.7	3.9	1.4	1.5	2.1	1.8
Architectural Eng'r.	1.5	1.1	1.6	2.4	3.8	4.5	4.6	4.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

4. PROBABLE NUMBER OF FUTURE GRADUATIONS *

Calculation Based on Growth In Fifty-eight Colleges of Engineering

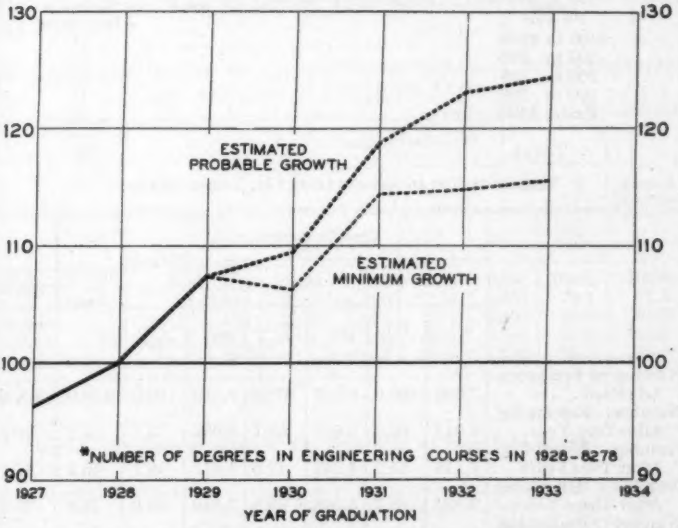
Year of Graduation	First Degrees Per cent of 1928	
	Minimum	Probable
1927	96.4	96.4
1928	100.0	100.0
1929	107.4	107.4
1930	106.3	109.4
1931	114.5	118.8
1932	114.8	123.1
1933	115.6	124.4

Number of degrees in 1928—8,278

* *Ibid.*, page 221.

5. Percentage Increase in Graduations

Calculations Based on Growth in 58 Colleges of Engineering *



6. Enrollment of Graduate Students in Day Courses December 31, 1929 *

	Degree			Tota
	Engrg.	M. S.	Ph. D.	
Engineering	710	837	61	1,608
Physics	6	153	155	314
Chemistry	9	345	311	665
Total	725	1,335	527	2,587

Data from 110 institutions. 71 institutions reported a total enrollment of 2,835 students, 248 of whom were unclassified. 39 institutions reported no graduate courses.

7. Enrollment in Evening Courses in Collegiate Engineering Subjects December 31, 1929 †

Institutions included	111
Number offering Evening Courses	22
Number receiving credit for Bachelor Degree	4,463
Number receiving credit for Graduate Degree	1,760
Number of students not candidates for degree	7,933
Unclassified	1,850
Total Enrollment in Evening Courses	16,006

* *Ibid.*, page 322.

† *Ibid.*, page 324.

8. Tuition for Engineering Courses

Data from 87 Institutions

Tuition Per Year	Number of Institutions
$400 to $450	11
300 to 399	13
200 to 299	16
100 to 199	17
Under $100	30
Total	87

9. Record of Total Eliminations in Three Classes *

	Class Graduating in						Average Percentage	1926 Report
	1927		1928		1929			
	No.	Per Cent	No.	Per Cent	No.	Per Cent		
Number of Freshmen Admitted	7,696	100.0	8,915	100.0	9,519	100.0	100.0	100.0
Number Remaining After One Year	4,615	60.0	5,623	63.1	6,992	73.4	65.5	60.6
Number Remaining After Two Years	3,418	44.5	4,241	47.6	4,441	46.7	46.3	42.1
Number Remaining After Three Years	2,821	36.7	3,548	39.8	3,810	40.0	38.8	33.8
Number Graduating in Four Years	2,159	28.1	2,392	26.9	2,613	27.5	27.5	28.1
Number Graduating in Five Years	470	6.1	559	6.3	311		6.2	
Number Still in College	82	1.1	191	2.1	763		1.6	
Number of Institutions	47		49		52			25

Record of Eliminations

Of 90 institutions, 42 reported that the college records indicated the cause of eliminations, 20 said the records only partly gave the causes, and 28 reported they did not.

Causes of Elimination †

Of 112 institutions 69 gave no report, 21 stated what they believed the principal causes to be and 22 others gave some detailed analysis of the causes. An analysis of the reasons given by the 21 institutions is as follows:

Reason	Given by
Scholastic Difficulty or poor ability	15
Finances	13
Lack of Preparation	8
Lack of Aptitude and Interest	6
Outside Work	4
Mathematics	3
Ill Health	3

* *Ibid.*, page 200.

† *Ibid.*, page 210.

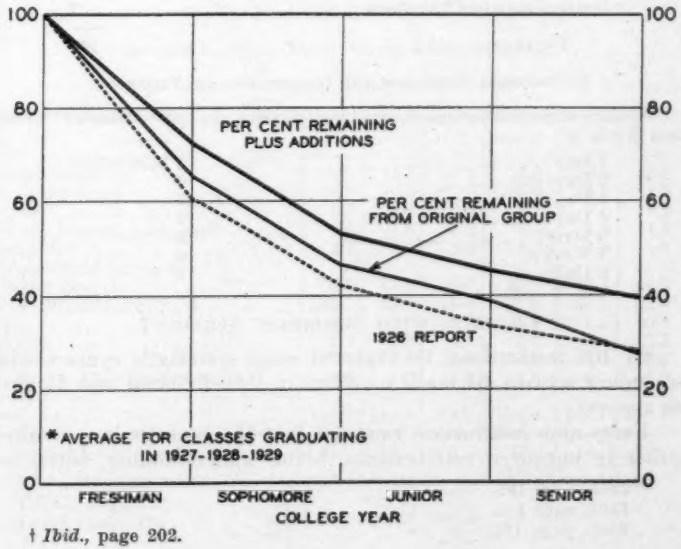
A review of the detailed analysis as given by 22 institutions indicates the principal reasons in order of importance to be as follows: Scholarship, Health, Finances, Personal, Lack of Interest, Preparation, Transfers to other colleges and departments.

10. ENROLLMENT RECORD OF THREE CLASSES, INCLUDING ELIMINATIONS AND ADDITIONS IN SUCCESSIVE YEARS

	Class Graduating in						Average Percentage
	1927		1928		1929		
	No.	Per Cent	No.	Per Cent	No.	Per Cent	
Freshmen	10,233	100.0	11,652	100.0	11,886	100.0	100.0
Sophomores	7,415	72.5	8,350	71.8	8,691	73.1	72.5
Juniors	5,484	53.6	6,092	52.3	6,307	53.0	53.0
Seniors	4,661	45.5	5,233	44.9	5,384	45.3	45.2
Graduating	4,104	40.1	4,533	38.9	4,732	39.8	39.6
No. of Institutions	56		59		60		

Note.—Enrollments taken at the beginning of each school year.

ENROLLMENT RECORD OF 3 CLASSES, † INCLUDING ELIMINATIONS AND ADDITIONS IN SUCCESSIVE YEARS *



† *Ibid.*, page 202.

Selection of Freshmen *

Of the 103 institutions, 84 reported admission on the basis of certificate from high school or college board examination. Five required either examination at the institution or college board examination, 13 limited admission to those in a specified portion of their high school class, 11 required a personal interview, 13 used psychological or aptitude tests in addition to the certificate, 13 mentioned other considerations, such as character testimonials and achievements in extra-curricula affairs, 2 required a medical examination and 5 reported no method of selection.

Educational Guidance and Orientation of Freshmen †

Data from 103 Institutions

Method Used	Number of Institutions Yes	No
Freshmen Week	73	23
Engineering Problems Course	29	67
Required Orientation Lectures	52	44
Series of Unrequired Talks or Lectures	22	74
Faculty Advisors	68	28

Institutions using none	7
Institutions using 1 method	13
Institutions using 2 methods	30
Institutions using 3 methods	37
Institutions using 4 methods	14
Institutions using 5 methods	2
Total	103

Educational Guidance and Orientation of Freshmen

Seventy-three institutions reported the following amounts of time for "Freshmen Week."

1 Day	5	Institutions
2 Days	6	"
3 Days	27	"
4 Days	12	"
5 Days	16	"
1 Week	6	"
9 Days	1	"

Contacts with Secondary Schools ‡

Of 103 institutions, 58 reported some systematic contact with secondary schools, 34 made no effort in this direction and 11 gave no report.

Forty-nine institutions reported that the contacts had resulted either in improved matriculants, better understanding, better co-

* *Ibid.*, page 196.
† *Ibid.*, page 183.
‡ *Ibid.*, page 172.

operation, and improved preparation, and thought it very worth while. Two were doubtful of the benefits and 3 reported no improvements.

It is apparent that many of the institutions have only recently established these contacts but the reports from them indicate considerable confidence in the desirability of continued contact.

STANDARDS OF EDUCATION

Required Units in Particular Subjects

Data from Eighty-six Schools *

Subjects	Number of Institutions					
	0 Unit	½ Unit	1 Unit	1½ Units	2 Units	2½ Units
Algebra	2	0	9	52	22	1
Solid Geometry	15	60	5	3	1	0
Trigonometry	65	18	0	1	0	0
Solid Geometry or Trigonometry	—	2	—	—	—	—
Physics	36	3	30	0	0	0
Chemistry	52	0	17	0	0	0
Physics or Chemistry	—	—	17	—	—	—

Courses and Curricula

Semester Hours Required for Graduation †

(Average Figures for Six Major Courses)

Subjects	E. E.	M. E.	C. E.	CH. E.	E. M.	I. E.
Mathematics	18.5	18.1	18.2	17.9	16.5	15.6
Physical Science	20.7	19.3	20.0	25.2	22.2	21.5
English	9.0	8.9	9.1	8.7	7.5	11.2
Modern Foreign Languages	1.2	1.0	1.2	5.3	1.8	1.9
Economics	4.7	5.0	5.3	4.3	4.5	11.9
Technological Subjects, Major Branch	39.0	41.0	50.0	44.9	45.4	34.2
Other Technical Subjects	23.5	22.9	18.4	21.6	31.2	22.4
Shop	4.6	7.2	1.7	1.9	1.2	6.4
Drawing	7.2	7.8	7.1	5.6	6.4	8.2
Electives	10.4	9.3	8.4	6.7	5.9	12.2
Physical & Military Education	4.6	5.0	4.6	4.3	5.1	4.9
Total	143.4	145.5	144.0	146.4	147.7	150.4
Number of Institutions	51	44	51	41	15	17

* *Ibid.*, page 429.
† *Ibid.*, page 430.

Have any significant changes been made in teaching methods?

NUMBER OF INSTITUTIONS REPORTING SIGNIFICANT CHANGES IN TEACHING METHODS AND EXPERIMENTS IN METHODS *

	Significant Changes	Experiments
Yes	30	26
No	34	32
No Report	37	43
TOTAL	101	101

No. 1. No.

No. 2. None, except through reports of the representatives of the teaching staff who attended the summer session of the S. P. E. E.

No. 4. No.

No. 5. ——

No. 7. ——

No. 8. No significant changes in general policy; departmental changes have been made.

No. 10. There have been no outstanding changes in teaching methods; though as a result of faculty discussion and particularly of departmental staff conferences, minor improvements have been adopted from time to time.

No. 11. Courses and methods changing like a cork on water, but the fundamental methods in vogue for 80 years are not deviated from to any extent by any professor.

No. 13. ——

No. 15. Adoption of divisioning according to ability in freshman and sophomore work—considered successful. Course in elementary engineering mathematics to bridge gap between high school and college work. Same reduction of extent of ground covered in certain subjects in order to provide greater thoroughness.

No. 16. No.

No. 17. ——

No. 18. None.

No. 19. ——

No. 23. ——

No. 24. ——

No. 25. Many meetings, discussions and conferences. It is felt that individual thought and interest have been stimulated. There is no desire to force changes or establish standardized procedure.

* Bulletin No. 11, page 522.

No. 26. ——

No. 27. No.

No. 31. Several changes have been made which are worthy of note: The work of the classroom is co-related with that of the shop in the following courses: (*a*) Production engineering (this course would be impossible as conducted without co-operative students); this course is largely based on the case problem method with its material drawn to a great extent from the shop. (*b*) Industrial management; the major divisions of this subject, as presented in "Anderson," are worked over by the student by corresponding case problems, the material for which must be again taken from the co-op plants.

No. 32. No changes of significant value.

No. 33. ——

No. 34. All of our laboratory exercises are conducted as "studies" rather than as "tests." The student is encouraged to increase his confidence in his ability to predict results from a knowledge of his theory and to compare these predicted results with the observations from his laboratory studies.

No. 36. No changes of this character have been made in the last few years.

No. 38. No.

No. 39. None.

No. 42. We have adopted the method of devoting one two-hour period a week to problem and computation work in connection with courses in mechanics, and we may use this method in other courses if it is successful in the mechanics courses.

No. 44. ——

No. 46. ——

No. 48. No.

No. 49. In freshman and sophomore courses in English and mathematics, the sections have been segregated on the basis of ability, the "fast moving" sections covering the ground more thoroughly and more extensively.

No. 50. More problem work—less lectures—more design work.

No. 51. There has been a rather definite trend in most of our departments toward placing a greater responsibility on the individual student; the emphasis has been on *learning* rather than *teaching*. More and more "project" work has been introduced, or the student is en-

couraged to investigate some problem on his own account.

No. 52. ——

No. 54. The policy of close personal supervision over the work of a small group of selected students characterizes the Thayer School.

No. 57. No significant changes.

No. 58. ——

No. 61. ——

No. 62. None.

No. 63. ——

No. 67. ——

No. 68. Previous to 1927, supervised study periods were extensively used, particularly in mechanics. These have been largely discontinued because of the cost of that method.

No. 69. ——

No. 70. Only some minor changes where improvement has been made.

No. 71. None.

No. 72. ——

No. 74. None.

No. 75. No.

No. 77. ——

No. 79. Emphasis is laid upon improving methods of teaching but the improvement is generally left to the teacher. A definite plan for improved teaching is being worked out by the faculty.

No. 81. The most significant change made recently has been in the establishment of a Department of General Engineering in 1924. This department consists of the freshman work which is common to all the branches of engineering. It has an administrative head who gives two thirds of his time to his administrative and advisory work with the students, the latter being an important feature. The orientation and problems courses for freshmen come under his supervision. During the past few years placement tests have been given entering freshmen to be used as a basis for sectioning. Resectioning on the basis of ability is carried out throughout the year with considerable success.

No. 82. None.

No. 83. No.

No. 84. Nothing of any significance.

No. 85. ——

No. 87. There have been no real changes made recently except that more attention has been paid to methods of conducting laboratory work.

No. 89. Juniors and seniors, seniors especially, are expected to, and do, work under less direct leadership of teacher. Placed more on own initiative.

No. 91. No material changes made.

No. 93. We have two honors group courses in electrical engineering. Various minor changes have been made in several courses as a result of the S. P. E. E. investigation. In the departments of chemical engineering and civil engineering the curricula have been altered in accordance with suggestions on the unified plan discussed in S. P. E. E. meetings. (In general we feel that our plan of small classes and individual attention to the student works well.)

No. 94. In addition, constant effort has been made to reduce the numbers, in the section, particularly in freshmen and sophomore mathematics.

No. 95. ——

No. 96. None that are of sufficient importance to report. During the last two years, the Committee on Educational Policy has given some attention to possible improvements in the quality of teaching; so far, however, while there has been considerable interest aroused in the problem the actual quality of teaching has not been greatly changed. The securing of high class men for the faculty and the promotion of a friendly feeling and free discussion among the members is encouraged.

No. 97. ——

No. 98. More emphasis on student work and less on lecture instruction.

No. 99. Weekly chemistry and physics demonstration lectures have been added to the regular recitation and laboratory work. Improved results are being obtained. Physics for all technology students has been placed in the sophomore year. In electrical engineering mathematics is being emphasized more in junior problem work. Architectural students are finding the physics that has been especially designed for them more interesting than the physics usually given engineering students. Graphical methods will be used more in teaching these students mechanics in the future than has been our practice.

No. 100. ——

No. 101. Only minor, except greater attention is being paid to the individual students. Orientation tests serve as placement tests and the results for freshmen are placed in the hands of the instructional staff within three or four days after the opening of the first semester, where they are used for individualization of instruction. Sub-collegiate courses in English and mathematics have been developed for those who have poor preparation.

No. 102. No.

No. 104. No marked changes in method of presenting subject matter.

No. 105. ——

No. 106. ——

No. 107. S. P. E. E. Discussions of methods are studied for application to our conditions.

No. 111. Gradual elimination of the "lecture" courses and the substitution of quiz sections. Reduction of size of sections to about 20 in most subjects. Increased emphasis on problem work and project work. Increase in the amount and great improvement in the character of laboratory courses in such subjects as materials of engineering, electrical and mechanical equipment and design.

No. 112. No.

No. 113. No changes made.

No. 114. ——

No. 115. A more general use of functional situations in which the solution of problems plays an important part. A special effort is made in the assignment of laboratory problems to avoid specific directions in many instances in order to cultivate the research attitude and point of view. A more general use of two-hour problem periods in courses in mathematics and pure and applied mechanics.

No. 117. I do not think so.

No. 118. ——

No. 119. No.

No. 120. While there has been a general improvement in instruction due to course organization and clarified objectives, there has been no unusual change in teaching methods. Supervised design, computation, and laboratory work have been emphasized at the college for a number of years.

No. 121. The exceptional student has been given more opportunity to exert himself, according to his own initiative and ability by being granted special projects under supervision. This is reserved largely for seniors in the School of Engineering. It has succeeded.

No. 123. ——

No. 124. ——

No. 126. Sectioning according to ability in operation in several departments, especially those having large freshmen groups.

No. 127. In the engineering physics courses, in addition to the regular lectures and laboratory work, the students are met in small tutorial sections (12 is the maximum number). The tutorial sessions are 2 hours in length and the work consists of supervised problem solving and quizzes both oral and written. An important point in connection with the written quizzes is that the quiz papers for an entire semester, written on printed form, are kept in a regular card catalogue file.

No. 128. ——

No. 129. ——

No. 130. We have been endeavoring, ever since the change in administration two years ago, to place the student more and more upon his own responsibility, in the last two years of the course.

No. 132. None except that the matter at various times has received faculty discussions.

No. 133. Wherever possible we assign two teachers to a class. This is a dangerous expedient, but if the necessary cooperation can be secured, it produces good results. One man, of course, is in charge of the class, and the other attends as a sort of a visitor and assistant. For example, one of the assistant professors attends the class of the department head in analysis of stresses, and is expected to indicate to the department head his opinion of how well the subject is "getting over." Incidentally, the assistant professor has charge of related work, and the department head attends his class as a sort of visitor-critic. When two professors are around, each will be more careful about what he says and does.

No. 134. No.

No. 135. No.

No. 136. None in our first four years.

No. 137. Our method of teaching has always emphasized the recitation rather than the lecture system. Blackboard demonstration by the pupils with the individual attention of the instructor to each student has characterized the method. In such subjects as chemistry, physics, etc., where illustrative lectures are necessary, recitations on the lectures supplemented by an approved textbook are required.

No. 138. ——

No. 139. ——

No. 140. None.

No. 141. None.

No. 142. ——

No. 143. We are striving very hard to reduce the lectures to a minimum and the participation on the part of the students to a maximum. We are advocating in each class in each course a short written quiz every day in the week and as little emphasis as possible being placed on final examinations. A written quiz each day is in line with current outside engineering practice and I need not go into the details of this. It solves many of the questions which arise concerning matters of attendance et cetera with the lower classmen.

No. 145. No.

What significant changes in educational policy or curricula have taken place in the last five years?

No. 1. When the results of the Survey of Engineering Education were published, the entire educational policy and curriculum were carefully reviewed. Our existing practices were found to be in practically complete accordance with those followed in other engineering schools of repute. A few minor changes were made, to bring about rather better distribution of students' time. No significant changes were found necessary.

No. 2. Change of degree practice—5 year chemical engineering course reduced to 4 year—Requirements for entrance raised—Revised curriculum evening graduate work instituted.

No. 4. Little change, except amount of mathematics required is being reduced. There is a tendency toward lightening schedules, especially in the sophomore year.

No. 5. In April, 1924, our curricula was revised so as to reduce the normal load of the student from 23 semester hours

to 20. In December, 1927, a further revision was made in order to reduce most of our courses to a three-hour basis, in this way simplifying the schedule. The total load on the student was not changed but considerable readjustment was necessary.

No. 7. Complete reorganization of Chemical Engineering Department and chemical engineering curriculum. The introduction of a course on the calculus of probabilities for all seniors. The introduction of "Honors Courses."

No. 8. Five-year course instituted five years ago; coöperative in last four years in three-month alternative periods.

No. 10. There have been no radical changes. From the usual departmental staff conferences minor changes have been made from time to time in subject matter, in methods of presentation, and in proportion of time assigned to preparation, to lecture, to classroom work, and to laboratory work.

There has been development and some extension of coöperative education. The coöperative courses in chemical engineering, it is believed, have been steadily improved, and are of demonstrated worth. A coöperative course has been added recently in railroad engineering. There has been development and extension of the summer camp courses in civil and in mining engineering.

No. 11. ——

No. 13. Standards are being raised steadily on the lines of the S. P. E. E. recommendations.

No. 15. No change found to be advisable. Courses are kept in step with developments.

No. 16. No marked changes have been made. Minor changes in conduct of certain courses. Four years ago mechanics (statics) was taken out of the second semester of the freshman year and moved forward into the sophomore year. A course, introduction to engineering, was substituted in freshman year and other necessary changes made.

No. 17. All of the engineering curricula have been revised to approach the recommendations of the S. P. E. E. Committee on Investigation and Coördination.

No. 18. Beginning 1930–31 the engineering courses will be administered under a School of Engineering, whereas heretofore they have been conducted in the School of Sciences, which included the degrees B.S. (general)

and B.S. (pre-medical). With a view to the inauguration of the new plan, the 1929–30 freshmen were enrolled as students in the School of Engineering.

No. 19. Up to four years ago three years of collegiate pre-engineering work was required as a minimum for admission to the Engineering School. Four years ago a two-year collegiate requirement as a minimum was put into effect.

No. 21. ——

No. 23. ——

No. 24. ——

No. 25. The following changes have been made. The elimination of the Department of Arts and Sciences within which the engineering work was formerly conducted, making the School of Engineering a primary, instead of a secondary, division of the university organization.

Transfer of the Department of Architecture to the newly created Division of Fine Arts. The elimination of graduate courses in engineering. The elimination of the degrees of B.S. in chemical engineering, B.S. in chemistry, and B.S. in physics (some students who registered prior to 1928 are completing work for these degrees).

The establishment of a course leading to the degree of B.S. in engineering which will go into effect in 1930–31.

No. 26. ——

No. 27. Introduced the grade point system as one basis for rating and encouraging the production of scholarship. Increase in number of non-engineering courses. Equalized the number of hours work required in each branch of engineering. Course in building construction added as an option in civil engineering.

No. 31. In 1925 we had a five-year coöperative course with four week periods of which the first year was non-coöperative. In 1925 we reëstablished summer surveying camp.

In 1926 we made first two years non-coöperative. We made courses in physics and calculus stronger. We unified the first three years of instruction, making them identical in all curricula. We added a course in theory of structures to all curricula. We increased the hours in corporation finance. We transferred economics to the sophomore year. We added physical chemistry, electro-chemistry, and thermo-chemistry to Ch.E.

course. We strengthened C.E. courses in highways, and concrete. We increased M.E. course in machine design. We added concrete to M.E. and E.E. curricula.

In 1927 we standardized on 48 hours' combined recitation and preparation as one semester hour and rated all our credits to nearest ¼ semester hours. (We have 18-, 20-, 11-, and 7-week semesters.)

In 1929 we added a course in aeronautical engineering.

No. 32. Curriculum hours reduced. Common freshman year for all divisions. Highly technical subjects made elective. Addition of industrial options in M.E. and A.E. Cooperative system open to all divisions.

No. 33. Beginning in September, 1929, all curricula in engineering were reorganized on a five-year program (one year full time and four years coöperative) and the old four-year curricula were abolished. This makes possible the inclusion of more cultural subjects and the better distribution of technical subjects throughout the curricula.

No. 34. Foreign language has been dropped as a requirement for graduation. Allowing a greater degree of freedom in selecting additional economics and courses in business in our School of Commerce. Giving at the end of four years the degree of B.S. (in Eng.) whereas formerly the College of Liberal Arts granted the B.S. degree to our fourth year men. Allowing fifth year students for the degrees of C.E., E.E., M.E. and I.E. a greater degree of freedom as to electives.

No. 36. We have changed from a school requiring three years for graduation, summer quarter being included, to a school demanding four years for graduation, no summer quarter being required unless it is for failure in previous work. The three-year course requires no English or economics, while a four-year course demands that a student study nine hours of English and nine hours of economics for three quarters.

No. 38. Lessening the required courses of freshman year from 20 credit hours to 16½ credit hours. Doing away with foreign language requirements. Introduction of electives. Revision of coöperative work. Introduction of required business courses.

No. 39. The rearrangement of courses to equalize the different years. Drawing has been reduced to give surveying to all men. Certain laboratory courses have been added.

No. 42. The College of Engineering began to function in the fall of 1928 with five divisions of engineering—chemical, civil, electrical, mechanical, and petroleum. Mechanical engineering was comparatively new at that time, and petroleum engineering was really a course in petroleum geology fostered by the Department of Geology. The Division of Chemical Engineering has thus far been identified with the Department of Chemistry and will probably continue to develop that way. The professors of chemistry are on the staff of the College of Engineering as well as of the College of Letters, Arts, and Sciences.

In electrical engineering we have just employed a man to give special attention to radio and high frequency work and to develop experimental work in general for us. In mechanical engineering there has been a very definite demand for work in aeronautics, and we have added six courses in aeronautical engineering to our curriculum in that division. A year ago the course in petroleum engineering was completely revised and an outstanding man was appointed to conduct this work. Inasmuch as the university is located in the midst of the greatest oil field activity in the State, it seems especially appropriate to develop this work.

During a number of years we have discussed in our faculty meetings the matter of giving work which would fit men particularly for commercial and industrial work, and hence we shall have, beginning next fall, a course called General Engineering which will include the fundamentals of engineering training and enough work in economics and commerce to make our students useful in a commercial and industrial way. In the Division of General Engineering we have included such work as general engineering, drawing, mechanics, materials, and engineering economics.

No. 44. The introduction of a certain limited number of free electives and a reduction in the amount of time devoted to shop and design courses.

No. 46. Reduction in number of hours devoted to "shopwork" and increase in number devoted to mechanical drawing and mathematics.

No. 48. More attention given to aero-dynamics and aero-plane design.

No. 49. Beginning in September, 1930, no applicants will be admitted who do not present 1½ units in algebra and 1½ units in plane and solid geometry. Applicants for admission whose rank was in lowest third of high school class must pass entrance examinations in algebra, plane and solid geometry, English, a general intelligence test, and in 4 additional units selected from high school list of credits. Curriculum requirement in English raised from 8 to 10 units. Average grade required for graduation has been materially raised.

No. 50. ——

No. 51. Men with honor stand (B or better) allowed considerable latitude for independent work. Curricula have not changed materially during five-year period.

No. 52. (Explanation of credit hour.) A credit hour normally consists of one hour of classroom work or equivalent pursued each week for a semester of ten weeks. Two laboratory hours are considered equivalent to one classroom hour.

No. 54. ——

No. 57. No significant changes in educational policy. We are reviewing our curricula carefully at present and there may be changes within the year.

No. 58. ——

No. 61. Fixing on 17-hour semester. Eliminating foreign language requirement. Cutting down on drawing and shop time. Reducing required engineering hours and making more elective hours. Creating a basic, or "general engineering" course, required of all engineering (except Ch.E.) students, so that a student may take his B.S. in general engineering, and have his 26 elective hours free. If his major is E.E., M.E., or C.E., the faculty of engineering may require that 12 of his elective hours be spent in advanced work in his chosen field.

No. 62. None. Our curriculum has been developed during the past five years, and all courses in the senior year were offered for the first time this year.

No. 63. None, but now under consideration.

No. 67. An adjustment has been made in the curricula making room for electives as indicated above. A required course in economics has been arranged in the sophomore year with the thought in mind that it will serve as a prerequisite to elective courses in economics or business administration in the junior and senior years.

No. 68. Until 1927, all courses (except Ch.E.) were alike until the senior year. Now the differentiation begins with the sophomore year. This differentiation in the senior year will be increased somewhat next year.

No. 69. Trend to more work in economics.

No. 70. A combined 6-year engineering-law course, 3 in engineering and 3 in law. The fourth year taken in the Law School. Grades in engineering necessary for recommendation between B and C. A course in "transportation" combining work in civil, mechanical, electrical, marine, aero, economics, etc.

Each sub-department is considering a possible complete rearrangement of its undergraduate work, bearing in mind that there are in general three types of men to educate: (*a*) those who expect to go into industry generally, (*b*) those who expect to become "professional" engineers, (*c*) those who expect to go into research work. Probably the last two will need an extra year.

No. 71. Addition of chemical engineering and general engineering courses.

No. 72. The discontinuance of a general engineering course.

No. 74. All curricula have been made identical through the first two years. (Effective 1927–28).

No. 75. A student may, by the permission of his adviser and with the approval of the Dean, be relieved from a professional requirement and substitute a special problem.

No. 77. ——

No. 79. Tendency to include more business and economics in engineering curricula and to make the engineering courses more the teaching of fundamentals rather than of practical details. Gradually courses in economics (general) and engineering economics are being introduced. To make room for these courses some of the details of the engineering courses are curtailed and the courses shortened or even omitted.

No. 81. ——

No. 82. Practically none.

No. 83. ——

No. 84. In E.E., M.E., Mar.E., the elimination of required courses in pattern making (4 units) and machine shop (4 units). There are now required 4 units of "materials treatment" including heat treatment, welding, cutting, shop demonstrations in wood and iron, etc. The

requirement by State legislature of 2 units of American institutions was added two or three years ago.

No. 85. No marked changes.

No. 87. Qualifying test for entrance. Change in maximum and minimum hours that students in Engineering College may take. A student must take at least 14 credit hours and in general will not be allowed to take more than 19. If, however, during the preceding semester he obtains an honor point average of 2.5 he may be permitted to take as many as 20. If the average was 3, 21.

Concerning the honor point system, in the Engineering College the student must fulfill the requirements of the curriculum with a standing of 1 in order to graduate. Very few important changes have been made in curricula in the last 5 years. Some subjects given in the junior year have been changed to the sophomore year and a few minor subjects have been added. Changes will be made in the year 1930–31.

No. 89. Have placed in most curricula some electives to be devoted to English, economics, etc., as the student may desire. Total number of credits required for graduation reduced from 150–152 to 145–147.

No. 91. None.

No. 93. Removed history from freshman year and replaced it by physics. We now have in this year chemistry, engineering drafting, English, mathematics, military, physics, physical training—unification—progressive development.

No. 94. The senior year's work in public speaking has crystallized into the presentation, before the entire student body by the senior class, of two seminars at the close of each semester. These seminars, as they are called, consist in reproducing, as nearly as may be, a hearing or similar situation, the principal parts being taken by the seniors and some juniors. The freshmen make brief reports of these seminars. The entire term is spent by the seniors in preparing and collecting their material and developing their arguments.

No. 95. ——

No. 96. The most significant change that has taken place in our educational policy has been the increasing of the number of credit hours in the various curricula. For a number of years we have been operating on the basis

of a normal of 15 units or credits per semester. We have changed this policy and now our standard is 17 per semester or 136 credits for the Bachelor's degree. Curricula common for two years with minor variations in third year for civils, electricals and mechanicals.

Attention is called to the fact that in all divisions of the university, except Engineering, the normal required credit per semester is 15 hours. The increase to 17 hours per semester in the College of Engineering throws it out of step with other divisions of the university, but in comparison with the commonly accepted standards of engineering colleges throughout the country it is still below the average. Owing to these local conditions it is likely that the present requirement of 17 hours per semester is a maximum.

No. 97. Freshman Engineering Day has been in operation three years, with sufficient success to warrant the establishment of an all-university Freshman Day, just prior to registration. Freshman adviser is given more time for contact. Freshman orientation continues as a 1 hour course throughout the year. After 10 years of evolution, this appears as a fixture, in the form of general lectures, demonstrations, exercises, experiments. It is not a problem course.

No. 98. Less insistence on particular courses and more general cultural and scientific courses.

No. 99. ——

No. 100. ——

No. 101. Reduction in semester hours required for graduation and reduction in the number of subjects the student is pursuing at one time; greater attention to the individual student.

No. 102. Up to 1927 differential calculus was taught in the spring term of the freshman year. Beginning with the fall of 1927, calculus was made a sophomore subject, a freshman orientation course was introduced, general economics was added to the sophomore year and some other minor changes made in the curricula. The total number of semester hours required for the engineering degrees was reduced from about 152 to 144.

We are now engaged in a general revision of all the curricula with a view to bringing them still more nearly in line with the fundamental principles laid down by the Board of Investigation and Coördination of the S. P. E. E.

No. 104. No changes in theoretical essentials. Modern language dropped to satisfy necessity for more time in technical fields.

No. 105. Marked development in chemical engineering. Facilities in ceramics have been greatly increased. Full option and new laboratory for sanitary engineering. Changes in mechanical engineering to provide additional optional work in mechanical engineering power and electrical engineering. Greater emphasis on economic content of courses. Minor changes in all curricula.

No. 106. Free electives have generally been increased.

No. 107. Findings of the S. P. E. E. used as a guide in changes still in progress.

No. 111. A general scrutiny of all subject matter and elimination of obsolete material. Emphasis of motivation courses in the freshman year. Increase in amount of economics and history.

No. 112. Elimination of thesis requirement in all curricula. Introduction of electives in nearly all curricula. Reduction in number of credit hours required for graduation (average requirement for graduation is two credit hours less than it was five years ago).

No. 113. Installation of specialized courses in highway, sanitary and metallurgical engineering.

No. 114. All mathematics given in first two years. Applied mechanics given by technical department. Time given to economics increased and placed in sophomore year. Elementary geology dropped. Public discourse added. Descriptive geometry added.

No. 115. Extension of elective system. Curricula have been revised in harmony with the recommendations of the Society for the Promotion of Engineering Education.

No. 117. Have reduced technical and increased general subjects.

No. 118. Reduction in credit hours required for graduation from 225 to 204. This was done four years ago.

No. 119. ——

No. 120. Engineering curricula have been reorganized for the purpose of strengthening the sequences in the engineering science and technology group and for the purpose of introducing a group on economics and administration apart from the engineering angle in the senior year. The freshman instruction has been organized for the purpose of orientation and courses have been grouped in a common curriculum for the de-

partments of mechanical, electrical, and civil engineering. A staff committee has been working upon the development and correlation of the work in the common freshman year. Another committee has made a study for the purpose of improving all matters pertaining to classroom instruction. Personnel work with educational and vocational counsel is being rapidly developed.

No. 121. The standards for entrance have been raised very definitely by accepting only those students who stand in the first or second fifth of their high school class, and requiring them to pass examinations if they stood lower than the second fifth of their high school class. The registrar states that about half of those taking entrance examinations have failed.

No. 123. ——

No. 124. The elimination of freshman shop work and the substitution of a course in "engineering problems."

No. 126. Entrance requirements raised from 15 to 16 units. Mathematics requirements raised from 3 to 3½ units. Age of special students raised from 20 to 23 years. Work in physics and economics increased. Curriculum in commercial engineering changed to industrial engineering. Options introduced in senior year of nearly all curricula. Architectural engineering added. Ceramic option offered in mining engineering.

No. 127. ——

No. 128. ——

No. 129. Degrees other than the mining and metallurgical first offered within above period.

No. 130. The curricula in metallurgical and geological engineering have been differentiated from an all inclusive course in mining engineering. We have in progress a thorough restudy by faculty of all curricula and will probably reduce somewhat the requirements for graduation, i.e., the number of hours.

No. 131. ——

No. 132. None.

No. 133. None, other than a gradual stepping up of the engineering and scientific content of the curriculum with a corresponding reduction of the requirements as to cultural courses.

No. 134. During the past five years there have been added to the engineering curriculum courses in mechanical, elec-

trical, ceramic and chemical engineering by the co-operative plan.

No. 135. Normal changes.

No. 136. None.

No. 137. An increase in time given to English, economics and business, the laboratory, and testing equipment has been greatly increased and better instruction provided. The courses of instructions are being studied by a special committee of the faculty with expert advice from the outside. This study by special committees and final action by the faculty will probably result in changes.

No. 138. Changing from a two-week alternating period to a three-week alternating period—then to a nine-week alternating period.

No. 139. There have been no radical changes in policy or curricula during the last five years. Minor changes in technical courses are made from time to time as changing practice requires. Slight changes in the electives have been made. At the present time history is the predominant elective. The course in aeronautic engineering was offered for the first time in September, 1929. Since it utilizes the same foundation courses as the other departments and also includes some technical courses given in other departments, there will be a senior class of aeronautic engineers ready for graduation in June, 1931.

No. 140. Introduction of special sections in economics and accounting primarily planned for engineers, more freedom for election in course given in junior and senior years.

No. 141. ——

No. 142. The elimination of the subcollegiate course 1924 (Sept.). Increase of 20 hours (credit) for B.S. degree in curriculum. Increase from 50 to 55 m. period of recitations. College algebra and plane trigonometry with college credit are required (4), elementary economics (3), English (6) and other technical subjects to make up 20 hours.

No. 143. The introduction of a course in physical computations which was suggested by a close study of the engineering colleges of England and Scotland. It was felt strongly that our boys did not have sufficient sustained computations. Also, I have mentioned the course in English. Following the educational philos-

ophy of John Dewey, we are of the opinion that it is very wise to have our college course here a cross-section of engineering life itself. Our course in English consists of a course in lectures in industrial history in the development of engineering; a list of readings for engineers which contain some classical engineering work. This furnishes the background. The young man is asked to write, write, write, write, write—a good deal of the writing being done under supervision following the principle that the only way to learn how to write is to write.

Each week, the entire freshman class is assembled with considerable formality and half a dozen papers are delivered and discussed formally by the convocation, adopting the same method as you would find in an engineering society. The results have to me been astounding, and we are gradually adding to the time spent so that ultimately we may hope to reach a 44 hour week. Much of the work done at home is done now within the college walls.

Again we are striking at the cross-section of real engineering life and I see no reason why, if we are willing to run a 44 hour week, that we should not get much of the work done within the daylight hours. From the standpoint of physiology, psychology and sociology, this would be a tremendous benefit and will solve many of the problems which have to do with lack of time and failure to apply.

No. 145. None; however, definite changes are planned and will be begun next year. (Note: We have formulated the curricula for degrees based on two years' straight college work, followed by three years on the coöperative basis. This will be put into effect beginning with our present freshman class, and will require 153 hours for graduation.)

Have any experiments in teaching methods been conducted?

No. 1. No.

No. 2. Supervised study in physics—sectioning according to attainment.

No. 4. No.

No. 5. ——

No. 7. ——

No. 8. ——

No. 10. Interesting suggestions have resulted from constant study of the regular faculty committees on graduate courses

and scholarships, and on undergraduate courses, and from a recent survey by a student committee. As a result of the latter there has been appointed and operative for two years a standing faculty and student committee for consideration of courses of instruction, teaching methods, etc. This committee's suggestions and findings have resulted in desirable changes. As far as we know this is the first instance of continuous and successful coöperative effort in which the undergraduates have borne so large a share. The operation of "honors" groups in some departments has proved very successful. The desirability of extension of this feature is clearly evidenced.

No. 11. No radical experiments.

No. 13. ——

No. 15. ——

No. 16. The experiment of having small divisions in mechanics meet informally around a table in place of regular recitations has been tried. The result has not been considered particularly successful as compared with the recitation. A change was made this year in teaching descriptive geometry. Recitations were dropped. One lecture per week followed by two two-hour drawing periods substituted. Results so far very satisfactory.

No. 17. ——

No. 18. None.

No. 19. ——

No. 23. ——

No. 24. ——

No. 25. ——

No. 26. ——

No. 27. True-false system is being tried in several courses.

No. 31. Courses in corporation finance and engineering law revolve largely around the case problem method; one half the scheduled time, approximately, is devoted to theory; the remainder to the application of the theory to case problems, the material for which comes from actual problems taken, largely, from the industrial community from which the student experience has been drawn.

The following experiments are being conducted:

1. Business English, a subject for upper classmen, will use as its material the reports submitted in corporation finance and engineering law.

2. The course in engineering problems will draw its material largely from the industries now coöperating with this institution in the training of engineers.

No. 32. The School of Education undoubtedly could furnish valuable information, but there is nothing new in College of engineering.

No. 33. ——

No. 34. No.

No. 36. It is not possible with our small staff to make any new experiments in teaching methods of this nature. Therefore no studies of this kind have been attempted.

No. 38. We have been experimenting with visual methods in parts of some courses, and believe this method takes the place of certain descriptive work.

No. 39. None.

No. 42. We have found the inspection trip program mentioned in the orientation of freshman students particularly worth while since we require written reports from the students after each trip. This has been found to stimulate the student's interest in what he sees and makes him more alert during the progress of the trip in getting material for his report.

No. 44. ——

No. 46. ——

No. 48. No.

No. 49. ——

No. 50. ——

No. 51. ——

No. 52. ——

No. 54. None.

No. 57. We have experimented with the objective type of examination to some extent and with fair success.

No. 58. ——

No. 61. ——

No. 62. None.

No. 63. ——

No. 67. We are using the Iowa Placement Tests as follows: Mathematics training, English training, and physics aptitude, and are sectionalizing the classes wherever possible. The following averages on Placement Tests at time of entrance last fall may be of interest in this connection.

	Mathematics	English	Physics
Freshman class	46.62	44.31	66.09

	Freshman group who failed during the fall quarter.	32.11	35.44	55.11

No. 68. ——

No. 69. ——

No. 70. A committee has charge of general matters relating to teaching and reports periodically to the faculty. Department of Drawing and Mechanism has and is conducting certain experiments. For freshmen who show signs of difficulty in their work attendance is required at a short period course in "How to Study."

No. 71. None.

No. 72. ——

No. 74. None.

No. 75. No.

No. 77. ——

No. 79. No radical experiments have been tried. Daily short quizzes have been tried with benefit in some of the larger classes.

No. 81. The most important experiment in teaching method is that of being carried on by Prof. C. C. More and his associates in the field of mechanics and structural engineering. Professor More developed the problem method and started the present movement for freshman problems courses. He is conducting his experiments along this line with remarkable success.

Another noteworthy experiment has been made in teaching freshman drawing. Prof. F. M. Warner uses the first quarter for pencil sketching, lettering, orthographic projections, etc., and the use of drawing instruments is not taken up until the second quarter. His course in descriptive geometry is also handled as a drafting problems course. He devotes only a few periods to the matter of rotation.

No. 82. No.

No. 83. No.

No. 84. None worthy of mention.

No. 85. ——

No. 87. This matter has been discussed by the Dean and heads of departments. No experiments have been conducted.

No. 89. None other than noted under (1) above.

No. 91. No experiments along this line have been conducted.

No. 93. Lectures on teaching methods by the head of the Department of Psychology have been given before the engineering faculty. Various teachers have tried and are trying out various expedients and methods in teach-

ing. We are experimenting with the honors group plan. We discuss teaching methods in our local S. P. E. E. meetings.

No. 94. ——

No. 95. An experiment in class size in mathematics has been undertaken; not completed. (Another one in physics showed no advantages or disadvantages to justify conclusions, in my opinion. Published by Earl Hudelson.)

No. 96. In certain subjects in the Mechanical Engineering Department an attempt is made to provide for the progress of the other members of the class. In order to do this a considerable portion of the work is based upon individual assignments in which general principles are stated and illustrated, with necessary references, problems assigned and questions asked to direct the thought of the student. The student is required to make a definite plan of procedure before beginning on his problem and makes a report when he has finished. New problems are then assigned. Requiring a definite plan of procedure reduces errors, saves time, and enables teachers to handle larger groups. An extension of this experiment is contemplated. The case or project method is largely used in civil engineering.

No. 97. ——

No. 98. No.

No. 99. A laboratory period in mechanics has been used for three years, in which students work problems. This has not seemed to be an advantage and is being discontinued. Advanced mathematics is being given to a selected group of juniors in electrical and mechanical engineering. This is proving helpful in teaching mathematics to sophomores since the upper classmen are using their mathematics to a greater extent in their engineering work. Freshmen are classified for mathematics by the Iowa tests and sectioned into three groups—fast, medium, and slow. The three groups cover the same ground by meeting in class four, five and six hours per week respectively. Success of plan not established. Instructors about evenly divided for and against it.

No. 100. ——

No. 101. New grading system. Special attention to superior students. Studies in teaching methods. Semester examinations. Student personnel studies. Studies of freshman placement tests. Experiments with double-pace sections. Orientation of freshmen. Studies in

higher education VII and IX include additional information.

No. 102. No.

No. 104. No.

No. 105. Several years ago a freshman section was formed for those who were found to be very slow or deficient in mathematics. The number of recoveries at first seemed promising, but time proved that such a small percentage made good, that the plan has been discontinued.

No. 106. Sectioning on the basis of ability has been tried in the Departments of Mathematics, Mechanics, and Electrical Engineering. The practice has been discontinued in mathematics and mechanics but is still in use to a limited extent in electrical engineering. All freshmen in the university take elementary English. In this course, the students are placed in A, B, and C sections, according to ability and previous training.

No. 107. No.

No. 111. No.

No. 112. None that appear to be of importance.

No. 113. No.

No. 114. ——

No. 115. Experiments are under way to determine the relation between class-size and teaching efficiency. The tendency is to increase the size of classes. Experiments with two-hour problem periods in mathematical subjects have proved very satisfactory. The Purdue rating scales for instructors have been used with significant and beneficial results especially when all staff members of a given department have coöperated in studying the results of the student ratings.

No. 117. Not in School of Engineering.

No. 118. ——

No. 119. No.

No. 120. No controlled experimental work has been done in teaching methods. The freshman engineering part of instruction has, however, been a very satisfactory demonstration. The schools have been very stimulating to the improvement of instruction in the courses of those who have attended and have introduced the study of instructional methods to the entire staff through the reports of those returning from them.

No. 121. ——

No. 123. No organized or large scale experiments. Individuals

and departments have been trying problem courses. Use of computing periods, etc.

No. 124. ——
No. 126. ——
No. 127. ——
No. 128. ——
No. 129. ——
No. 130. Less lecturing, more studying. Results satisfactory.
No. 132. None.
No. 133. None.
No. 134. No.
No. 135. No.
No. 136. ——
No. 137. In some of the senior work we are substituting the lecture system in a few courses.
No. 138. ——
No. 139. None.
No. 140. The text and methods in mechanical drawing have been changed this year. It is still too early to say whether the result will be satisfactory but it appears to be meeting the requirements. In some of the senior courses, we have tried the scheme of giving the students a general topic and meeting the group at infrequent intervals (something like honors courses). This has not been particularly successful and the regular tri-weekly meeting seems better. We have also assigned different men to take charge of the class group on different days and to handle the topics assigned for that day. This has been more successful than the other method.
No. 141. None.
No. 142. ——
No. 143. We are experimenting at the present time with the question of instruction in alternate periods rather than with continuous instruction. We believe that the examinations at the end of the period to be worthless. We are, I think, finding that emphasis on a few fundamental things is sound, but the multiplication of technical applications is absolutely unsound. We experiment concerning the teaching of mathematics, especially calculus, and we are giving most of our calculus at the present time as a part of our course in analytical mechanics. Again, it seems too simple to mention, but there seems no way to force young and immature students to form abstract concepts or reason abstractly. We are beginning to feel that the method

of alternate periods of instruction has some very definite and lasting advantages over a continuous method. A continuous method, is, we believe, somewhat akin to cramming and if the course is lengthened somewhat and given an alternate period, a professor or instructor is forced to good teaching methods, and the student gets something which he retains certainly a few weeks after the final examinations of the subject.

Our experiments seem to have proven that it is a huge joke to test a man's ability within a day or two after the course is finished and indications would point to the fact that, if his ability were tested five years after the end of the subject, he would retain mighty little of it under our present method of instruction.

No. 145. No.

What significant changes have taken place in the last five years regarding the number and quality of graduate courses?

No. 1. No graduate courses.

No. 2. Five years ago a curriculum leading to M.S. degree in chemistry was the only graduate activity. Last year curricula were added leading to the Master's degree in civil, electrical and mechanical engineering and this fall another in chemical engineering. Three years ago seven courses were given and now twenty-one courses are given, both excluding supervision of thesis work. All of these courses are given during the evening hours and a few in the daytime.

No. 4. The number of graduate courses given at night is increasing steadily. Some graduate work is being done now in day courses, notably in metallurgy.

No. 5. The number of graduate students in any of the last five years has been quite small so that very little graduate work has been done on other than a personal basis.

No. 7. No graduate courses.

No. 8.

No. 10. A complete revision of all courses given, into three classes: (1) Undergraduate—not counting towards higher degree; (2) Graduate and Undergraduate—courses of fourth year or senior grade; (3) Graduate—open only to graduate students (except with special consent of registration officers). For the Master's De-

* *Ibid.*, page 333.

gree 75 per cent of the work *must* be elected from group (3) as a minimum, 25 per cent *may* be chosen from group (2). The number of strictly graduate courses has been and is being extended annually. In 1929–30 a total of 321 graduate courses were listed in both terms by all departments at the Institute (as many courses in the second term are continuations of courses in the first term the number of subjects offered as graduate courses is considerably less than the figure given above).

No. 11. None—more given.
No. 13. ——
No. 15. None, save greater emphasis placed on chemical engineering.
No. 16. None.
No. 17. ——
No. 18. None.
No. 19. ——
No. 21. ——
No. 23. ——
No. 24. ——
No. 25. ——
No. 26. ——
No. 27. At present do not offer graduate courses in engineering.
No. 31. None.
No. 32. There are no graduate courses in engineering except those offered in Aeronautical School, where a fifth year in residence is required of those seeking the Aero.E. degree.
No. 33. No graduate courses are offered by the School of Engineering.
No. 34. The annual increase in graduates has been approximately 20 per cent. Approximately 55 per cent of our fourth-year graduates return to complete the fifth year for the degrees of E.E., C.E., M.E., and I.E. In the fifth year and fourth year more courses in economics and commerce are allowed.
No. 36. Graduate courses are not given at the University.
No. 38. Through a coöperative agreement with the Westinghouse Electrical and Manufacturing Company we conduct with them a coöperative graduate school in engineering, with an enrollment of about 250 graduate engineers and a varied curriculum. Many of the mature engineers of the company are on our staff as lecturers.

No. 39. Our graduate courses have been offered for the last five years only. The number is the same as that first offered. Our enrollment is increasing.

No. 42. ——

No. 44. None.

No. 46. None. We have had no resident graduate students in engineering for a number of years. Each year we have one or more graduates who are awarded the professional degree of mechanical engineer, civil engineer, electrical engineer, chemical engineer on the basis of their professional experience and an examination and thesis.

No. 48. ——

No. 49. None. Plans now being matured to develop graduate courses of instruction in all departments.

No. 50. ——

No. 51. There has been a distinct increase in the requirements in the direction of greater rigor.

No. 52. ——

No. 54. ——

No. 57. We do not offer graduate courses.

No. 58. ——

No. 61. ——

No. 62. One graduate course was offered this year. This is the first attempt to give graduate work in the School of Engineering.

No. 63. No graduate courses.

No. 67. The number of graduate courses has been increased, and much of the work has been increased in difficulty.

No. 68. They have been extended and more closely defined.

No. 69.

No. 70. Several new courses added in higher work in mechanics (also given in Summer School). Additional graduate courses in electrical, chemical.

No. 71. None.

No. 72. ——

No. 74. No considerable changes.

No. 75. ——

No. 77. ——

No. 79. Relatively few graduate courses are given. There is a tendency to emphasize mathematics in the graduate work in engineering.

No. 81. ——

No. 82. Began to offer a unique course (graduate) in the administration of mineral industries.

No. 83. Not giving graduate work in engineering at present.

No. 84. Little change except for an increase in the number of courses and a strong tendency to encourage graduate study.

No. 85. ——

No. 87. Until the year 1927–28 practically no graduate work was done in the College of Engineering. In that year through the provision of three graduate fellowships, one each in civil engineering, physics, and chemical engineering, an interest was started in graduate work. Regular graduate courses were offered during 1927–28 and 1928–29. Graduate students other than those awarded the graduate fellowships have been taking the advanced work leading to the degree Master of Science.

No. 89. The number of such courses has been increased considerably. The requirements now demand a higher quality of work.

No. 91. Several graduate courses in mining and metallurgy have been added.

No. 93. More courses of high quality have been added.

No. 94. ——

No. 95. ——

No. 96. No changes have been made of any importance, except that these courses are being more and more elected.

No. 97. They have all been surveyed by the Graduate Council, both as to content and instruction. Prerequisites have been more clearly defined, and distinctions drawn between graduate courses and advanced undergraduate courses.

No. 98. All that we have, have been added in the past five years. We have a few strictly graduate courses.

No. 99. In order to fulfill the objectives of the Graduate School, that is to "meet the needs of superior students who are preparing to become teachers in colleges or universities, or investigators, and to offer opportunities to qualified students for a more advanced training than they can obtain in an undergraduate course," the last five years was marked by a restriction rather than an expansion of graduate work. The number of departments represented in the graduate bulletin as offering graduate courses for major work towards the Master's degree has been reduced from 22 to 14. The number of courses in these departments has not been increased very much. The quality has been improved, particu-

larly in the science departments. Considerable emphasis has been placed upon the requirement of a valuable thesis. In most cases the theses have been accepted for publication in reputable periodicals.

No. 100. ——

No. 101. Increased in quality and variety.

No. 102. None.

No. 104. Graduate Department of University incorporates graduate work in engineering.

No. 105. Additional courses in chemical and sanitary engineering.

No. 106. Considerable enlargement in facilities and number of courses.

No. 107. Number of courses offered has been reduced.

No. 111. Engineering graduate work here is finding itself and the subject matter of graduate courses is being placed on a truly graduate basis with emphasis on the truly research type of work. Introduction of courses and facilities for work leading to the doctorate.

No. 112. Number of courses listed in catalog about the same. Courses are better organized and more are being actually given.

No. 113. ——

No. 114. ——

No. 115. None.

No. 117. Number about same. Quality much improved.

No. 118. ——

No. 119. Graduate work was not offered five years ago. At the present time complete graduate and Masters' degrees are offered in the Departments of Industrial Arts, Education, and Vocational Education. Arrangements will be completed to offer a Master's degree in the Department of Mechanical Engineering within the next year. The number of graduate students is small at the present time but prospects are indicating a considerable increase in the coming year.

No. 120. There has been a slight change in the number of graduate courses. Few students have taken graduate work in the past but a new plan of fellowships in the engineering experiment station has increased the graduate work materially. It seems quite probable that this work will not develop extensively beyond those groups which are working upon particular problems in the experiment station which have special significance to the State of Oregon, and who are employed upon a half-time basis. With the development of the engi-

neering experiment station and research work upon problems of significance to the State, the need for part-time assistance and the strength of student interest in research problems will gradually increase the amount of graduate work offered. It will, however, be some time before graduate students will be enrolled in such numbers as to require the organization of graduate classes in specific courses. Graduate work at the present time is carried on with instructors acting as tutors and counselors and because of the ability of those assigned to graduate instruction, it is carried forward at a high level of efficiency.

No. 121. The number of graduate courses has increased only moderately. Graduate students have been restricted in number, and only the best have been accepted. Students from Germany have applied and have been accepted.

No. 123. ——

No. 124. The number of graduate courses has been somewhat increased and their quality has undergone a systematic improvement. Effort has been made to more nearly correlate the graduate subjects so that they would fall more or less into groups with a definite objective.

No. 126. Graduate courses increased from 24 to 63. Quality improved by more definite organization and greater demand for graduate work. Number of graduate students increased from 4 to 16. Better organization for graduate research. Six part-time graduate research fellowships now available.

No. 127. ——

No. 128. Each department has added, at different times, new courses both academic and in research work.

No. 129. Graduate courses offered for first time within this period.

No. 130. Graduate work inaugurated this year for the first time.

No. 131. ——

No. 132. None.

No. 133. No graduate courses offered.

No. 134. There has been a considerable increase in the number of graduate courses offered in the following departments: Mathematics, Physics, Chemistry and Textile Engineering.

No. 135. No graduate courses.

No. 136. No graduate work at present.

No. 137. No graduate courses.

No. 138. Do not give graduate work.

No. 139. The College of Engineering and Commerce and the School of Applied Arts of the university offer opportunities for graduate work in engineering, commerce, the applied arts, and in the basic sciences of those branches, leading to the appropriate professional graduate degrees.

No. 140. No graduate courses offered in engineering. The school is small and no attempt has been made to work up a graduate department. Under Professor C. B. Andrews, work has been started in a small way on soil mechanics. Last year the course was offered in the evening and was elected by a number of practicing engineers. This year the work offered is along the physical science side but next year we plan to offer a course on concrete for practicing engineers. We have only a small number of prospects for such courses and must concentrate on different lines during each year.

No. 141. None.

No. 142. ——

No. 143. We do not offer any graduate courses in engineering.

No. 145. No graduate work in engineering.

Where is the administrative control of graduate work placed and how is it supervised?

No. 1. ——

No. 2. The planning of the graduate courses was carried out by a Committee on Graduate Study and the supervision of the work is placed with the Dean of the College who is also Director of the Evening Session.

No. 4. Placed in Educational Senate, and supervised by the Committee on Graduate Degrees, consisting of one representative from each college.

No. 5. The control of graduate work is placed in the hands of a Committee on Higher Degrees and the Dean. We give only the Master of Science degree.

No. 7. ——

No. 8. ——

No. 10. All graduate work is in charge of a Faculty Committee on "Graduate Courses and Scholarships"; membership consists of one member from each Department Committee on Graduate Students—about 16 members in all. Dean of Graduate Students is Chairman. Department Committees present recommendations for degrees to the Graduate Committee which, in turn,

recommends to the faculty. Committee acts with power on approval of graduate courses and on award of graduate scholarships and fellowships.

No. 11. Committee of the Faculty.

No. 13. ——

No. 15. With heads of appropriate departments.

No. 16. In the Graduate School, supervised by the Engineering Division which reports to the Dean of the Graduate School.

No. 17. Administration control resides in the Committee on Advanced Degrees and supervision is directed by heads of departments.

No. 18. The administrative control of graduate work is under the faculty of engineering. Each head of a department is responsible to the faculty for the graduate work in his department. In the Engineering School, the department head is in all cases the major professor.

No. 19. The final year of the engineering course is graduate work in the sense that it is taken by students who already have the B.S. degree, but is an extension of the professional course in engineering and is under the control of the School of Engineering. Specialized graduate work in engineering subjects such as is taken by candidates for the M.A and Ph.D. degrees is under the jurisdiction of the Faculty of Pure Science, not under the Faculty of Engineering.

No. 21. ——

No. 23. ——

No. 24. ——

No. 25. ——

No. 26. ——

No. 27. ——

No. 31. We give professional degrees Ch.E., C.E., E.E., M.E., and A.E. for three years' professional experience and a thesis, to such of our graduates as care to do the work.

No. 32. All graduate work, except under 3 above, is at present under the Graduate School of the University, where no degrees in engineering are given. There is one policy, recently adopted, where graduates of other technical schools seeking credit for advanced degrees at their own alma mater, may take courses at the Graduate School here, such as in higher mathematics and physics, and then have such credit transferred to the Col-

lege or University affected, for recognized credit toward their degrees.

No. 33. ——

No. 34. The fifth-year work is under the control of the Dean and the teachers having rank of "Professor."

No. 36. The only graduate course that is offered at the University is that of the professional M.E., E.E., C.E., or Ch.E. The requirements for this are as follows: Three years after the student leaves college he is required to undergo a special oral examination after writing an acceptable thesis. The administrative control of this course is vested in the Dean of the College of Engineering and the department head who is most concerned with a special examination and preparation of the thesis.

No. 38. The administrative control is through the Graduate School of the University. The actual and technical control of the work is through the department heads of the Engineering and Mines Schools.

No. 39. Graduate work for one year, leading to degree of C.E., E.E., M.E., or Ch.E., is under the faculty of the School of Engineering, supervised by professors of school.

No. 42. ——

No. 44. Graduate work is under the control of the Dean of the Graduate School, but is under the direct supervision of the head of the department in which the major work is taken.

No. 46. With the Dean and Faculty of the Graduate School.

No. 48. ——

No. 49. It is under the Faculty and Dean of the School of Graduate Studies.

No. 50. ——

No. 51. It is under the general and final control of the Board of the Graduate School of Yale University. A special committee consisting of the Chairman of the Engineering Division (the associated engineering departments) and four of the engineering professors acting as a committee on higher degrees have direct supervision of graduate work. To this committee the individual departments report as to the work in their respective departments.

No. 52. ——

No. 54. ——

No. 57. No graduate engineering work offered.

No. 58. ——

No. 61. ——

No. 62. All of the graduate work in the University is placed under control of the Dean of the Graduate School and the Graduate Committee.

No. 63. ——

No. 67. The administrative control of graduate work is placed with: The Dean of the Graduate School; the Executive Committee of the Graduate School; the Engineering Graduate Committee; the heads of the departments.

No. 68. Administration in the departments and in the faculty of this college so far as nature and extent of courses are concerned. Registration is with the Dean of the Graduate College. A graduate committee of this faculty composed of all full rank professors has immediate supervision of graduate work.

No. 69. In the hands of the Graduate School of the University. Students majoring in engineering supervised by head of engineering department in which major is elected.

No. 70. Control is in the hands of the Dean of the Graduate School. Supervision by a separate committee appointed to be responsible for each student, so far as work, examinations and recommendations are concerned.

No. 71. None done at present.

No. 72. ——

No. 74. By faculty of College of Engineering.

No. 75. Administrative control of graduate students is under the supervision of the Dean of the Graduate School and supervised by the professor under which the work is taken.

No. 77. ——

No. 79. Work is carried on in the separate departments but a graduate student must register with the professor appointed to act as a dean of graduate students.

No. 81. ——

No. 82. In a Graduate Study Committee.

No. 83. All graduate work of University is under control of Graduate Council, the administrative officer of which is the Dean of the Graduate School.

No. 84. Control is vested in the Dean of the Graduate Division. Supervision is by regular members of the faculty offering courses, under the direction of department chairmen.

No. 85. All graduate work is centered in the Graduate School but each college has, of course, an interest in its own graduate work as well. Each graduate student elects his

own committee subject to general supervision of the central committee of the Graduate School.

No. 87. The Graduate School is under the direction of the Committee on Graduate Studies. This committee consists of the Dean of the College of Arts and Sciences, Agriculture, Engineering, Commerce and Journalism, Law, Pharmacy, and Teachers College and the Vice-President of the University. The Chairman of this committee has been the Dean of the College of Arts and Sciences. At the present time only courses leading to the degrees of Master of Science and Master of Arts have been offered. Starting with the college year of 1930–31 there will be an organized Graduate School under full time Dean and courses leading to the Ph.D. degree will be offered.

No. 89. In graduate council and Dean of Graduate School. Back of these the general faculty of the University and the Academic Council. The Academic Council is composed of the Deans of the various schools, President, two members elected from the faculty.

No. 91. The Dean of the Graduate School, the Dean of Engineering and the head of the department concerned arrange the program for each graduate student. The work in each course of study is supervised by some individual member of the staff selected by the head of the department.

No. 93. The Dean of Graduate Study is administrative head. Graduate faculty and head of the department concerned supervise the work. The Dean of the college concerned recommends the candidate for the appropriate degree.

No. 94. ——

No. 95. Graduate School. Dean and Executive Committee. Committees for various groups of subjects (as "Physical Sciences and Mathematics").

No. 96. The graduate work is under the control of the faculty as a whole. The outline for the graduate year is planned by the department and adopted by the faculty so that all students pursue a regular curriculum. None of our advanced engineering work is taken under the direction of the Graduate School. Our graduate year is outlined in the same manner as the undergraduate with regular advanced subject matter and about forty to fifty per cent elective.

No. 97. A graduate college Dean, administrator. A graduate college faculty, nominally in control, but seldom meeting. A graduate council created by the faculty, and acting in the double capacity of a legislative body and an executive body. It establishes rules of procedure and standards of excellence. It passes upon the sufficiency of courses for graduate rating. It approves or disapproves for graduate instruction the personnel recommended by departments. Departmental graduate committees (*e.g.*, Engineering) which examines proposed student programs and recommends approval by Dean when satisfied that the complete program is of proper grade and homogeneity. Departmental adviser, appointed individually for each graduate student.

No. 98. Graduate Committee.

No. 99. Graduate work is offered, under the supervision of the Dean of the Graduate School, by competent members of various departments of instruction and research. These members constitute the faculty of the Graduate School. The general administrative functions of the faculty are delegated to the Dean and the Council.

No. 100. The administrative control of graduate work is placed in the Graduate School and the work is supervised by the professor under whom the major is carried.

No. 101. Graduate Council headed by Dean of Graduate School.

No. 102. University Committee on Graduate Work, supervised by department heads.

No. 104. Committee on Graduate Study.

No. 105. At present under a committee on graduate work for general supervision. Direct supervision by the college. The Graduate School is in the process of reorganization and all engineering work will be included in the industrial and science group. A chairman for this group has been elected effective 1930.

No. 106. By a graduate faculty and a Dean of the Graduate School.

No. 107. Graduate Committee. Major professor.

No. 111. In the Dean of the Graduate College with a committee in the Engineering College to correlate with the Graduate College. Essentially the character of the graduate work in the College of Engineering is directed by the Dean of Engineering.

No. 112. Administrative control of graduate work lies with the Graduate Council. Programs for graduate students are prepared by the major instructors under general

regulations prescribed, and are subject to approval by the Graduate Council.

No. 113. Graduate Committee.

No. 114. Committee on Graduate Study. Dean of school. Head of department.

No. 115. The administrative control of graduate work is in the charge of a graduate committee.

No. 117. Dean of Graduate School, Graduate faculty and head of department in which student majors.

No. 118. ——

No. 119. The administration of the graduate work is invested in the Dean of the Graduate School, who is responsible for setting the standards of the work of the department. Each department is responsible for building up its curriculum and seeing that the necessary courses are offered. The Dean of the Graduate School has an Advisory Committee consisting of a representative from each of the six divisions in the college offering graduate work.

No. 120. The control of graduate work is placed in the hands of a graduate committee but the responsibility for the thoroughness and efficiency of it remains with the department in which the degree is received. The standard of graduate work has been raised by the supervision in the Engineering School and by a common policy accepted within that school.

No. 121. The Graduate School consists of those who offer accepted courses in graduate study. The Graduate School, presided over by a Dean, passes on graduate courses and approves recommendations for degrees.

No. 123. ——

No. 124. The Dean of the Graduate School supervises the graduate work with the advice of the Graduate Council.

No. 126. Control in committees of six members—"Committee on Graduate Programs and Degrees." This committee unifies practices; encourages and passes an offering of courses; passes on programs of study of graduate students; and recommends granting of degrees.

No. 127. The work in the Graduate School is carried on under the supervision of the Committee on Graduate Studies. This committee is headed by the Dean of the Graduate School. The Engineering College has one member of this committee.

No. 128. In a Faculty Committee.

No. 129. Supervised by the head of department concerned.

No. 130. Graduate Committee, to whom heads of departments giving graduate work are responsible.

No. 121. ——

No. 132. Under head of department in which the degree is to be secured.

No. 133. No graduate work offered.

No. 134. The graduate curriculum is under the control of a committee consisting of the Dean, Registrar, and the heads of the degree-granting departments. The head of each department supervises the work of his own department.

No. 135. ——

No. 136. No graduate work at present.

No. 137. No graduate work.

No. 138. ——

No. 139. In addition to the usual research work in connection with the various departments of the College of Engineering and Commerce and the School of Applied Arts, an Institute of Scientific Research has been organized in which to carry on definite types of research work of fundamental character connected with basic industries. At the present time the Institute of Scientific Research consists of five major units: 1. The Research Laboratory of the Tanners' Council of America. 2. The Commercial Club of Cincinnati Research Survey. 3. The Research Laboratory of the Lithographic Technical Foundation. 4. The Basic Science Research Laboratory. 5. The Sound Research Laboratory.

(Quoted from catalogue.)

No. 140. All graduate work of the University is under the control of a committee on graduate work and the administrative work is handled by the Chairman of the Graduate Work Committee. The general committee selects for each candidate a special faculty committee. At present there are no candidates in engineering.

No. 141. None.

No. 142. ——

No. 143. ——

No. 145. ——

Research and Publications *

Number of Institutions Reporting	80	
a. Number of Research Fellowships	234	
b. Number of Part and Full Time Assistants	511	
c. Number of Published Bulletins	600	(Approx.)
d. Reported Expenditures for Research	$1,301,871	

* *Ibid.*, page 330.

A complete report of research in engineering colleges has been prepared under the direction of Dean R. A. Seaton, Chairman of the Committee on Research, and is published as a supplement to Vol. XXXI, No. 6, JOURNAL OF ENGINEERING EDUCATION.

S. P. E. E. SUMMER SCHOOLS

Impressions as to Values Received.

No. 1. Very good.
No. 2. Very much worth while, inspiring.
No. 4. Very useful and got a great deal out of it.
No. 5. Marked value.
No. 7. The institution has defrayed all expenses. Good contacts for the younger instructors. However, it seems that the summer schools are attended too largely by professorial talent and not largely enough by instructors.
No. 8. Very great.
No. 10. Excellent.
No. 13. Three men attending last summer found the courses valuable.
No. 15. They are very considerable and well worth the effort.
No. 16. Decidedly advantageous. Stimulating interest and inspiration.
No. 17. As far as we have observed, this work has been very helpful.
No. 19. Each of them has expressed himself as believing that his time was spent to very great advantage in the summer school.
No. 27. Sufficiently great to warrant especial emphasis upon its continuation and our attendance.
No. 32. Favorable in every instance. Would encourage attendance by all eligible.
No. 33. They are very much worth while.
No. 36. It is my impression that teachers who have attended the special summer school work have been helped and given a new out-look in their teaching profession. Contacts made in changing work are not only helpful but very desirable. It is my belief that such summer schools courses should be greatly strengthened and improved, though this is not a criticism of former summer schools.
No. 38. Most valuable.
No. 39. Great value.
No. 44. By the contacts with other instructors and the interchange of ideas on teaching, our faculty members have

been more than repaid for the time and expense incurred.

No. 46. Benefit derived from lectures relatively small. More desirable to have expert teachers conduct model classes. Personal contacts with men from other institutions regarded as the most valuable feature.

No. 49. One member of our faculty seems to have been stimulated by the experience.

No. 51. They seemed to get a good deal of inspiration from the experience; new points of view; and profited by meeting others working in their field.

No. 52. Never attended.

No. 54. Very well worth while.

No. 57. Was valuable for the instructor who attended last summer (1929).

No. 61. The schools are felt to be of very considerable value, both from a technical and inspirational standpoint.

No. 62. We believe that the teacher is greatly benefited and that this is reflected in his daily class work.

No. 63. Those who have attended have most favorable reports and the impression is that they are well founded.

No. 67. Very good.

No. 68. Benefit has been general rather than specific.

No. 69. Of very great value.

No. 70. Favorable.

No. 72. We have had one man attend an S. P. E. E. Summer School. He returned amply repaid for the expense and trouble of the trip.

No. 75. The attendance upon the meetings has been the main source of keeping in touch with progressive educational policies. The reports of the Board of Investigation and Coördination contains a comprehensive group of facts which are invaluable to Engineering Education.

No. 79. Very beneficial.

No. 83. Perhaps of some value to the man who goes. Doubtful whether others have benefited.

No. 84. Many points of help; contacts with others gave ideas to our attendant, although the subjects discussed were not in his line. He believes the schools are very helpful.

No. 85. Excellent. We endorse the plan heartily.

No. 87. Believe much may be gained by attending the summer schools.

No. 89. Very much worth while.

No. 91. Excellent results. More men should go.

No. 93. The time is well spent. Teaching has been improved and those who have attended given greater confidence in our own methods.

No. 95. Very much worth while.

No. 96. That they are not permanent.

No. 97. I am gratified by the enlivened interest in methods, in particular. Our instructors are urged to attend, if practicable.

No. 99. Willing, but in their regular fields of work instructors have outside employment during the summer and feel that they cannot afford to miss this opportunity to add to their yearly income.

No. 100. Many new points were obtained by both teacher and student who were in attendance from Ohio State University. At Purdue the work was considered valuable, especially that done in committees.

No. 101. Very gratifying.

No. 105. Very favorable.

No. 106. Of very considerable value. General in effect rather than specific.

No. 107. Values received are well worth while.

No. 111. Have no information.

No. 112. Reports of those of our faculty who have attended the schools have been favorable and in most cases enthusiastic. I regard the schools as of great value.

No. 113. Personal contacts with men conducting summer sessions and discussions with men from other institutions.

No. 114. Very beneficial.

No. 115. Two members of the engineering staff have attended the summer schools at their own expense. The reports are especially favorable and other members of the staff have been urged to attend the summer schools.

No. 118. The institution has been represented every year at individual expense. The above together with fact that we shall be represented at both sessions for 1930 indicates our favorable opinion.

No. 119. Worth much more than the expenses involved.

No. 123. Excellent. Representatives at two schools have rated them as very valuable.

No. 124. Have been very valuable in offering suggestions of improved methods both by means of lectures and by contact with those in attendance.

No. 126. Of inestimable value.

No. 127. Those members of our engineering faculty who have attended the S. P. E. E. Summer Schools have been very much pleased with the benefits received.
No. 130. We are sending a man to Pittsburgh and believe results will justify the expenditure.
No. 132. Good, members attending have been pleased.
No. 134. Favorable.
No. 136. They are very much worth while.
No. 137. The contact with others and the work done has greatly benefited those who have attended.
No. 138. Very valuable.
No. 141. Very worth-while. Will have representative present at all future schools.
No. 143. So far as I can understand, results have been very good indeed. Several of our men attended last year.
No. 145. None have attended.

45 per cent of the institutions reporting defray the expenses in whole or in part of their representatives at the S. P. E. E. Summer School.

General Administration

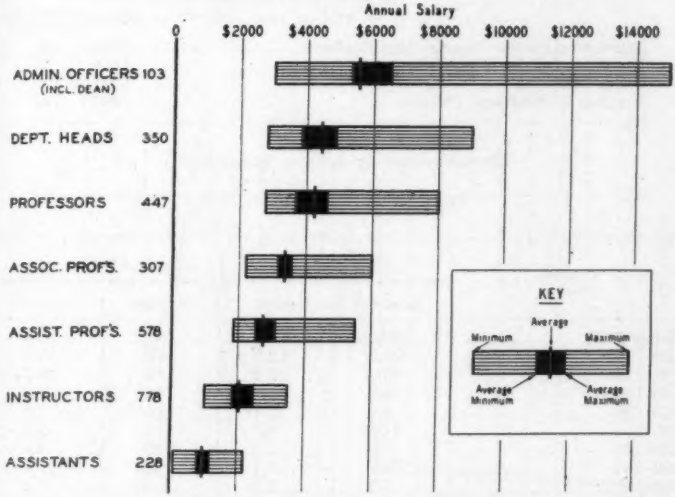
Salaries of Engineering Teachers *

	Number of Insts.	Number of Cases	Maximum Salaries		Average Salary	Minimum Salaries	
			Highest	Average		Average	Lowest
Administrative Officers (Incl. Dean)	58	103	15,000	6,540	5,540	5,330	3,000
Department Heads	51	350	9,000	4,880	4,430	3,845	2,800
Professors	52	447	8,000	4,630	4,230	3,660	2,750
Associate Professors	54	307	6,000	3,575	3,370	3,165	2,200
Assistant Professors	66	578	5,500	3,115	2,745	2,515	1,850
Instructors	65	778	3,500	2,490	2,050	1,845	1,000
Assistants	44	228	2,200	1,190	965	800	75

* *Ibid.*, page 309.

Salaries of Engineering Teachers

Data from 66 Institutions—Dec. 31, 1929



Teaching Load *

(Data from 89 Institutions)

	Clock Hours per Week		
	Max.	Aver.	Min.
Department Heads	22	13.2	6
Professors	28	15.4	10
Associate Professors	30	16.3	10
Assistant Professors	32	17.1	9
Instructors	30	17.6	6

Personnel Systems

Methods in Placement of Seniors

Number of Institutions Reporting	89
Personnel or Placement Officer	31
Dean or Similar Administrative Officer	27
Department Heads	79
Institutions Using One Method Only	47
" " Two Methods	36
" " All Three Methods	6

* *Ibid.*, page 313.

OPPORTUNITIES FOR COLLEGE GRADUATES

Data from 47 Institutions

	Total	Average per Institution
Number of Senior Engineering Students	4282	91
Number of Industrial Visits	1618	35
Other Contacts	5757	123
Number of Positions Offered	7697	164

DISTRIBUTION OF INITIAL SALARIES *

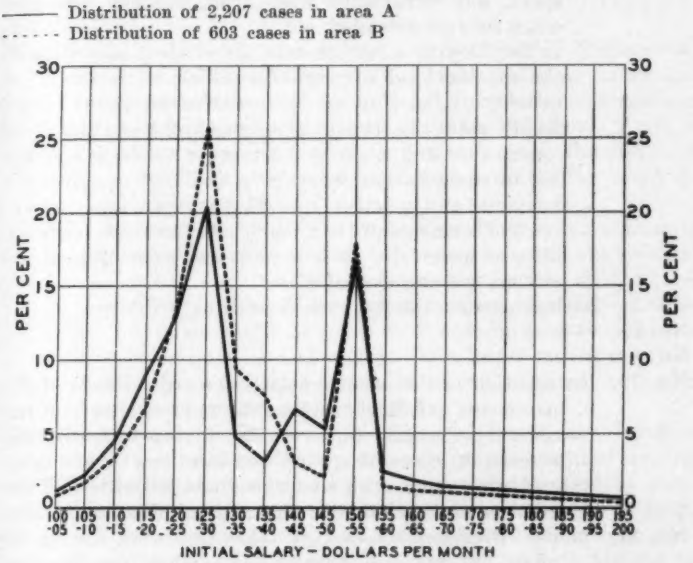
Engineering Graduates—1929

Monthly Salary	Area A		Area B	
	Number	Percent	Number	Percent
Below $120	395	17.9	82	13.6
120–124	282	12.8	80	13.3
125–129	451	20.4	155	25.7
130–134	105	4.8	56	9.3
135–139	68	3.1	46	7.6
140–144	148	6.7	18	3.0
145–149	118	5.3	12	2.0
150–154	368	16.7	108	17.9
155–159	53	2.4	9	1.4
160–174	98	4.4	19	3.2
175–199	91	4.1	14	2.3
Above $200	30	1.4	4	0.7
Total	2207	100.0	603	100.0
Number of Institutions	18		17	

Area A—East of the Mississippi and North of the Ohio and Potomac Rivers.
Area B—West of the Mississippi and South of the Ohio and Potomac Rivers.

* *Ibid.*, page 234.

INITIAL SALARY OF ENGINEERING GRADUATES IN 1929



Brief statements of types of records kept for placement purposes.*

No. 1. Card Index System kept by Executive Secretary, Alumni Association.

No. 2. Following data for each position. 1. Name of Company. 2. Address of Company. 3. Man to interview. 4. Type of position. 5. Salary. 6. Qualifications. 7. Remarks. 8. People sent and their findings.

Record of Applicant. Name, address, telephone, class, course, type of work desired, minimum salary, experience, remarks, positions sent to and findings.

No. 4. The usual statistical information is collected from every member of the senior class, including an Employment Information Sheet from which seven or more blueprints are made. These blueprints are for distribution to the personnel representatives who visit Carnegie, or to send out through the mail to companies who wish to correspond with the graduates. The information sheet includes such items as name of student, course taken, college and home address, date of birth, na-

* *Ibid.*, page 235.

tionality, physical defects, if any; how summers were spent, any experience with firms, student activities, other colleges attended, etc.

The faculty members rate the student according to the specific kind of work for which he is fitted. A member of the Bureau, by means of an Interviewer's Blank, rates the student according to his character, his appearance and address, whether or not he is convincing in conversation, whether he is likely to succeed in business, and whether reports from previous employers and members of the faculty are favorable, unfavorable, or uncertain. Scholarship and psychological test ratings are also available.

No. 5. Each department keeps such records as it desires.

No. 7. ——

No. 8. ——

No. 10. In addition to the usual scholastic records, Heads of Departments and Registration Officers of courses kept regular files (usually card records) giving personal characteristics, notes of special qualifications or handicaps and connection with undergraduate activities. These records are available to the Alumni Placement office.

No. 11. None. President's secretary takes this work during the year. Scores and perhaps more than one hundred great corporations and others send personnel officers here between February and June each year looking for members of the graduating classes.

No. 13. ——

No. 15. Scholastic record detailed and averaged. General acquaintance with extra-curricula activities. Department members' reaction as to personality.

No. 16. None.

No. 17. Personnel records and collegiate grades are available in certain departments for placement purposes.

No. 18. A student qualification record card is filed in the personnel office giving student's name, age, nationality, residence, languages read easily and spoken easily, student activities participated in, class record, opinion of the interviewer, aptitude and interest, practical experience had, and, altogether, the information usually sought by personnel managers in industry.

No. 19. No special records kept. File of letters of prospective positions open in the year for recent graduates and also for those out longer.

No. 21. ——

No. 23. ——

No. 24. None kept.

No. 25. ——

No. 26. In the Dean's office is kept a card file of all Engineering School graduates, giving name, address, class and occupation—kept up to date by a yearly card sent out to each man and by the graduate bulletins. There is also a special card kept for each man who indicates that he wishes to be notified of positions for which he might qualify.

No. 27. Students' academic record kept on file together with data covering any practical experience he may have accumulated, and instructor's impression of his attitude, interest, character, and extra-curricular activities. Also a follow-up of progress or change in work or advancement in rank and salary. This latter record is voluntary on the part of graduates but a request to which they have eagerly responded.

No. 31. Records of shop work as coöperative students, together with class grades, are available for placement of seniors.

No. 32. Our blank is much like the typical blank used by companies. On one side is space for scholarship records, character ratings, and the estimates of various professors. The other side is for the student himself to fill out and includes identification material, space for picture and place to describe the job preferred. A copy of this blank is attached.

No. 33. We keep very complete records of both scholastic achievement and coöperative work. A detailed account of the type of job, kind of work done, report of the employer, and similar data, cumulative over the five-year period, becomes available at graduation for purposes of vocational guidance and placement. Thus the personal qualifications, aptitudes and abilities of each student are quite definitely known which makes the problem of placement much less difficult than would otherwise be the case.

No. 34. File records.

No. 36. The Engineering Department itself keeps no records for placement purposes for several reasons. First, all of our graduates are employed immediately after all commencement activities are over. Those who are temporarily out of a position write in to the Dean of Engineering who informs them of any position that may be open. He himself gets this information from

the companies who are constantly requiring new help. Second, a placement bureau is being started under the administration of the College of Education. This has not functioned long enough for us to see whether or not it is entirely successful.

No. 38. Optional with department heads. He arranges the conferences between employers and students.

No. 39. Our regular scholastic record cards with additional cards in office of Dean giving professional record of graduate. The Personnel Director has record blank of his own.

No. 42. ——

No. 44. ——

No. 46. No special type of records. Prospective employers hold personal conferences with Dean or with department heads.

No. 48. No special records kept for placement purposes. Regular records consulted when necessary.

No. 49. Scholastic records on file in office of Registrar (copies in office of Dean), and individual record cards showing details of career following graduation, the latter maintained by Alumni Representative on the basis of periodical questionnaires sent to graduates.

No. 50. ——

No. 51. Full records of mental and scholastic aptitude rating. Scholarship, extra-curricular activities, work for self-support. General personnel rating by instructors.

No. 52. As this is a coöperative college, placement is an undergraduate, as well as a graduate, problem. Careful records are kept throughout the student's course of all data bearing on placement. Pre-college industrial experience is recorded at the outset. Entries are made throughout the college course on the basis of reports received each five weeks from the student's employer and from the student himself. In addition, we keep a record of the interviews of the student with the personnel officers. His vocational interests are checked frequently and recorded. After graduation an annual check is made of the positions occupied by alumni.

No. 54. Positions are offered to graduates on the basis of personal knowledge of the student and his special aptitude. We do not make any organized attempt to place men after their first position. It is not necessary.

No. 57. Records of all seniors (some begin in Junior year) kept at placement bureau, opinions of faculty and fellow

students, academic and extra-curriculum accomplishments, personal characteristics and preferences are recorded.

No. 58. ——

No. 61. Our numbers are so small this is not necessary.

No. 62. Our record of coöperative work done by the students shows the name of the employer, the type of work done by the student, the length of service, the amount of pay received, and the employer's estimate of the student's ability.

No. 63. A placement officer of Tufts College has been recently appointed. As yet he has had little to do for engineers. The records of the Dean's office are available and through his secretary had been constantly useful. The chief responsibility rests on the department heads who handle the matter on the basis of personal acquaintance.

No. 67. Scholastic records and personal qualification records made by faculty members.

No. 68. Rating of each student by three instructors on personal qualities: (1) habits, (2) popularity, (3) address, (4) mental calibre, (5) self-reliance, (6) industry, (7) speed, (8) accuracy, (9) reliability, (10) initiative, (11) forcefulness, (12) judgment. Record also of physical defects and of peculiarities.

No. 69. None other than standard student records.

No. 70. A one-page (or both sides of an 8×5 card) personnel record is kept—photo, scholarship, personality, etc. Each professional department keeps its own records, and almost entirely handles the placement work for its seniors.

No. 71. With small classes no "system" is needed for record.

No. 72. ——

No. 74. None really necessary. We have thorough personal acquaintance with every graduate.

No. 75. ——

No. 77. None.

No. 79. No detailed records kept. An alumni directory is published every few years, but this gives only the present positions of those whose address is known.

No. 81. ——

No. 82. Registration form on which the student lists information regarding age, degree, experience, major and professional work, and faculty references. Reference forms on which the major professor, supervisor of practice

teaching, and general references give estimates of the student's ability. Note: The records refer to the placement of teachers as that is the only form developed as yet.

No. 83. Personnel cards (attached).

No. 84. Mining—personal records in Dean's office. Mechanical—personal records, personality records and grades, scholastic records, etc. C. E.—personal and scholastic records. In the Alumni Bureau of Occupations, quite a complete record of those who are there listed, letters of recommendation, etc., and a perforated card system for ready selection of those listed in any group or occupation.

No. 85. We have a fairly fully developed personnel and placement bureau.

No. 87. List of graduates, where and by whom employed and a list of employers interested in our graduates.

No. 89. High school record. University scholastic record. University extra-curricular activities record. Record of employment during vacation.

No. 91. A simple record sheet is made out by each senior at the beginning of the year. This record sheet is also kept as a permanent record after graduation, being brought up to date from time to time.

No. 93. Scholastic records. Outside activities. Personal characteristics. Opinions of teachers regarding student.

No. 94. Each department head keeps in contact with outside sources, and with the graduates. Arrangements are made with a number of large companies for interviews between their representatives and seniors.

No. 95. Scholastic records. Evaluation by faculty members.

No. 96. Photograph; degrees; major interests; college and home addresses; personal data; high school information; college information; practical experience.

No. 97. Personal and scholastic. Experience, general and technical. College activities, clubs, etc. Activities as a citizen. Preferred employment. Current salary (subsequent to graduation).

No. 98. High school and college records. Photograph. College activities. Vacation activities in part. Intelligence test scores.

No. 99. Use made of scholastic record, in which is kept record of class and extra-curricula activities of student. On account of having small classes and heads of departments meeting men usually for three years in classes,

detail records of many characteristics of men are not made.

No. 100. In one department Qualifications and Characteristics records of upper-classmen are obtained from their instructors and student associates. Some departments obtain a complete report from the industry where the student has been employed during vacation periods. In several cases the departmental faculty consider the qualifications of individual students for certain positions which have been offered. All departments keep records of demands.

No. 101. A composite record of each student's personality ratings, scholastic record, health record, intelligence test, practical experience, student activities, vocational preference and other general information is kept for every engineering student. Detailed material is kept in a record folder and the composite is made on a 5×8 personnel card for use of employers and teachers. Copies of the personnel records are furnished to the heads of the various schools and departments regularly.

No. 102. None kept.

No. 104. Personnel information about Engineering students available in Dean's office.

No. 105. All correspondence and calls relating to employment are kept on file and are available for student reference. An annual letter is sent out to alumni and former students and a card catalog file is kept of addresses, positions held, etc.

No. 106. Scholastic record. College activities. Outside experience. Earnings during college course. General opinion of senior instructors as to personal characteristics. General nature of work preferred (in some departments).

No. 107. Regular file.

No. 111. Engineering Personnel Leaflets. Interview and Placement Record. Note: Beginning next year, we will use a rating sheet for each senior. These will be filled out by heads of departments and members of the teaching staff.

No. 112. (Character and Personality Record attached.) Form used by electrical engineering department. Most departments employ similar card records.

No. 113. No specific records kept.

No. 115. Ratings—placement tests of freshman week. Scholar-

ship record. Personality ratings. Health record. Record of membership in student organizations and offices held.

No. 117. Records of students in each department kept by head of department.

No. 118. Aside from scholarship records no records are made. Members of staff know every senior intimately. Each member of staff is requested to report on seniors. Estimate of each senior determined by staff conference after individual reports have been filed. Estimates are filed for future reference.

No. 119. No permanent placement records are kept in the Division of Engineering, however, the Secretary of the Former Students' Association is entrusted with keeping a thoroughgoing set of records of the men and positions which are open from time to time.

No. 120. The records kept for placement purposes are just in the process of organization and development. They will be very similar to the American Council personnel sheet with the addition of a sheet for the alumni records which will give specific information regarding employment and address.

No. 121. For assistance of industrial representatives and for our own use, we have a personnel record system, copy of which is enclosed.

No. 123. Senior classes in each department number from 12–20. Small enough so that the need for special records for the purpose has not yet been felt. The department head has two years of rather close contact with each individual.

No. 124. These are kept by the different departments and have not been standardized. In the larger courses, instructors are asked to rate seniors on industry, initiative, personality, and similar characteristics and this is kept on file.

No. 126. No special records for this purpose.

No. 127. Recent photographs. Record of grades made during entire college course. Record of practical engineering experience. Record of college activities. Record of personal history. Rating by three professors on scholarship, industry, initiative, accuracy, self-reliance, common sense, personality, appearance, and resourcefulness.

No. 128. ——

No. 129. Our placement bureau, in charge of one of our professors,

maintains a clearing house of information regarding positions and aids the graduates, whether recent or of former years, to find satisfactory positions. Throughout the year the bureau keeps in touch with the industries so that each graduate may have an opportunity at the end of his course, to consider several openings. A card record is kept showing positions available, students recommended, names of students interested in securing employment, and dates on which they will be available.

No. 130. Interviews and correspondence with industrial departments and research divisions.

No. 131. No formal records kept. The school keeps in touch with alumni and has an employment record of each.

No. 132. No definite system but results have been effective

No. 133. The number of graduates is so small that all of the four professors have complete first-hand knowledge of every man. For our files we keep a biographical sketch of each student, prepared by the students themselves, along with grades and a card on which the composite opinion of all professors in the college who have taught the men is given with regard to such qualities as initiative, personality, leadership, etc.

No. 134. Seniors are graded by several of their professors on personal qualities—a composite rating of these qualities is then put on the record cards of the students.

No. 135. Contacts with industry, employment managers visiting institutions.

No. 136. Nothing permanent has been done in this matter as our first graduates were turned out last June.

No. 137. A full record of each student is kept on file and all information for placement purposes in the office of the registrar. The heads of departments consult these files.

No. 138. In connection with the coöperative work, the student and employer submit periodical reports regarding the outside work. Some students are retained by their employer after graduation.

No. 139. The College of Engineering and Commerce is on a cooperative basis, and we have a coördinator for each department of Engineering. The records give a detailed statement of the practical experience which a student has procured; also the employer's ratings on the various jobs held. It indicates, too, his class standing, his activities in student affairs, his physical record, and a brief statement of his history prior to his entrance to college.

No. 140. Each graduate is listed and a record kept of their employment. As the number is still very small this office is acquainted with the individual and knows his ability.

No. 141. Personnel blanks and scholarship records.

No. 142. ——

No. 143. We have never found any necessity for keeping records for placement purposes. Our students are all placed, most of them, before they graduate and the number of men out of work is extremely small. A case has not come to my attention for the past two years.

No. 145. No records kept.

How is information of employment opportunities conveyed to seniors and undergraduates? *

No. 1. By personal conferences and notices on bulletin boards.

No. 2. Information of opportunities is sent to suitable applicants on file by mail or telephone. Also by visiting representatives from large industries and corporations.

No. 4. The Bureau of Recommendations invites companies, interested in the graduates from the engineering and industries courses, to send representatives to the University. Another type of contact is made with companies interested in receiving applications by mail. The Bureau itself merely forms the contact between the graduate and the employer, it does not do any particular vocational guidance work with the senior. However, due to the fact that it invites companies and furnishes information to the students, it does control the so-called exploitations of the young graduate by the mere fact that the less reliable concerns are not included on its accredited firm list. The usual information as to salaries, working conditions, promotion policies, etc., is collected by the Bureau and given to the graduates.

No. 5. By department heads, by direct investigation, and through posted notices.

No. 7. By visits from representatives of the leading industries, and individual cases by faculty advisers and department heads, and faculty committee on student relations.

No. 8. By direct contact between seniors and faculty in the several departments.

No. 10. Notices on general and department bulletin boards. Notices to seniors in class. Facilities for contacts of students with visiting industrial representatives.

* *Ibid.*, page 250.

No. 11. By personnel men of corporations. By letters filed with President's secretary. By heads of the various departments.

No. 13. Through department heads interviews are arranged with representatives of employers.

No. 15. Letters and notices are posted on special bulletin boards. General notices read to the section as a whole. Individual personal conferences with certain promising candidates.

No. 16. We have no difficulty in placing our engineering graduates. The demand exceeds the supply. Representatives of leading industries and organizations meet the students during the second semester of senior year and present their opportunities by meeting groups and in personal interviews.

No. 17. Notices are posted on bulletin boards. Applications are handed in person to interested students. When personal representatives come on the ground they are shown every possible courtesy to enable them to interview personally all students interested, and inquire into the respective records of these students.

No. 18. Notices are posted on bulletin boards. Seniors are interviewed and opportunities in the professions made known.

No. 19. Notices of positions which are open are often posted on the Dean's bulletin board. Letters from employers are referred to appropriate department heads.

No. 21. ——

No. 23. ——

No. 24. Personal interview.

No. 25. ——

No. 26. Bulletin board notices in corridors. Notices read in class by the instructors.

No. 27. Conferences. Bulletin board. Posters.

No. 31. Department of Industrial Relations makes personal contact with seniors, or recommends names to employers looking for seniors. Undergraduate employment is all handed by this department under the coöperative plan.

No. 32. Like all other schools, we arrange for interviews between the recruiting officers of companies and the seniors. We also have employment bureau which attempts to register the seniors and to acquaint them with opportunities which they have gathered through means of circular letters. Finally, through the coöperative plan we are able to learn of many employment wants

and in the latter case transmit the information to students through notices or announcements by one of the professors in class.

No. 33. Approximately 50 per cent of the graduating seniors annually remain with their coöperative firms. A large number of representatives of industry visit the school annually and have personal interviews with members of the graduating class. Every senior is accorded the assistance of his coördinator in finding suitable after-graduation employment; but the responsibility for getting the job rests squarely upon the shoulders of the student. It is not uncommon for every member of the senior class of over 200 men to have secured an after-graduation job before Commencement.

No. 34. By company representatives mainly. Also various companies will write.

No. 36. Approximately from eight to ten companies write in each year concerning our engineering seniors. Six to eight of these companies send representatives who interview our students and pick the best men. In the past we have had little or no difficulty in placing all of our graduates.

No. 38. Through the department concerned. Usually directly from the department head to the individual student.

No. 39. By Dean and personnel director, by personal announcement, by letter from personnel director, by announcement in our daily newspaper.

No. 42. Bulletin boards and oral announcement by professors. The companies that employ large numbers of engineering graduates send their representatives to the campus each spring to interview the seniors and make offers of positions.

No. 44. Opportunities for employment are offered seniors and undergraduates by representatives of the various industries who visit our college at times previously arranged for. These representatives consult our college records and the various department heads, and then hold personal interviews with the students.

No. 46. By announcement in classes.

No. 48. By personal interview.

No. 49. Through bulletin board notices and personal interviews with Deans and heads of departments. Part time employment for undergraduates is handled through Board of Recommendations centered in office of Alumni Representative.

No. 50. Bulletin boards and interviews.

No. 51. The Personnel Bureau gets out regular bulletins stating what firms are seeking men and describing the positions open. From the records on file and in coöperation with the departments of study, the Bureau selects a man or a group of men who appear to be eligible for a particular job, or for any of several jobs, and notifies the student or students. If any of the students is interested, the company or firm is informed of the fact and very commonly arrangements are made for representatives of the firm personally to interview the candidates. The firm may secure more intimate information through consultation with the department chairman. The Bureau endeavors to give the students the fullest possible information regarding the firms offering positions. There is a Yale Graduate Placement Bureau in New York City, which coöperates with the Bureau in New Haven. The New York Bureau concerns itself not only with finding positions for graduates temporarily out of a job, but also endeavors to locate desirable openings for men who may wish to change their location or type of work.

No. 52. Generally through the personnel officers of the Extramural School.

No. 54. Directly by Dean or through medium of representatives of prospective employers who come to Hanover for that purpose.

No. 57. By telephone or note. Opportunities for interviews are arranged by director of bureau. Ninety firms have representatives at the college this year; sixty-five last year. Last year 85 out of 116 registered with the Bureau were placed before graduation. The Bureau also finds term and summer employment for undergraduates; post office Christmas work, etc.

No. 58. ——

No. 61. By posting of literature on bulletin boards. By having representatives of employers interview students.

No. 62. For graduate employment, opportunities are presented to all of the seniors; those interested may apply. Undergraduates are assigned to coöperative work by the coordinator.

No. 63. Largely through the Secretary to the Dean and by department heads.

No. 67. By personal conferences and through the visits of industrial representatives.

No. 68. Bulletin board and conference with heads of departments.

No. 69. Through verbal and bulletin board announcements, circular letters, personal conferences.

No. 70. Information published on regular bulletin boards and also in "Official Bulletin" in the *Michigan Daily*. Some departments keep special files open at all times to inspection by students. Preliminary contacts are made in some cases at the end of the first semester, by sending out to prospective employees records, photos, etc., of men who will graduate.

No. 71. Through personal interviews.

No. 72. ——

No. 74. Personal conversations, and also bulletin board notices, announcements at engineering society meetings, and correspondence.

No. 75. ——

No. 77. ——

No. 79. From companies which send a personnel agent to the school. From direct application from companies for men. An employment bureau is being formed with a stenographer in charge of records and addresses so quicker connections can be made when a call for a man comes in.

No. 81. ——

No. 82. The school authorities write to the Appointment Bureau listing vacancies which they wish to fill. The Appointment Secretary then recommends those graduates fitted to handle the type of work described. The school officials may choose among several candidates qualified.

No. 83. By interviews, letters and personal visits.

No. 84. By personal communication, either oral or written, by statements to senior classes (College of Mechanics especially), by posting notices on bulletin boards in the different buildings, and by listing opportunities with the Alumni Bureau of Occupations. The student branch members of the founder societies are urged to list their names with Engineering Employment Service in San Francisco.

No. 85. By bulletins, usually, but we depend mostly upon representatives of industry who visit us.

No. 87. By personal contact between instructors and students. By bulletin boards. Notices in the daily bulletin.

No. 89. Lectures by representatives of corporations. Talks by faculty members. Talks by outside engineers.

No. 91. By personal interviews and talks to the senior class.

No. 93. Bulletin boards. Announcements in classes. Recruiting visits of company representatives.

No. 94. By department heads.

No. 95. Posted notices; talks by employers' representatives; conferences.

No. 96. Bulletins and through department heads. Also visiting representatives of industry.

No. 97. Bulletin board, class notices, direct contact. Rather informal, as a whole.

No. 98. Personal conference with professors.

No. 99. Bulletin boards and visits of company representatives.

No. 100. By department heads—either individually or by posting information on bulletin boards.

No. 101. Information of employment opportunities is conveyed to the seniors: 1. By representatives of industrial concerns visiting the campus and interviewing the seniors. 2. By the Personnel office of the Schools of Engineering through collected information over about eight hundred concerns, and interviews with seniors and undergraduates concerning employment. 3. Through teachers and administrative officers. 4. Through surveys of employment and return by the company of information and request for recommendations.

No. 102. Directly or indirectly through the department heads.

No. 104. Dean or department heads.

No. 105. Through department heads and bulletin boards.

No. 106. By talks from faculty and largely by literature and explanations from representatives of industries. Also by bulletin boards.

No. 107. Bulletin board and personal contact.

No. 111. Personal interviews with heads of departments and personnel officers. Illustrated with lectures by representatives of industrial concerns. Booklet, pamphlets, catalogs, etc., available in the Engineering Personnel office. Personal interviews with industrial representatives who visit the campus. Senior inspection trips.

No. 112. Personal interviews, seminary talks, bulletin boards.

No. 113. Personal consultations.

No. 114. Through bulletins. Public announcements and visits by representatives of industry.

No. 115. By a centralized-decentralized personnel and placement bureau. By department heads. By bulletin board announcements.

No. 117. Nearly all our seniors are engaged by employers or their representatives who visit the college and interview them. If any are not placed before graduation, they are usually placed by head of department, who gives them information at their home addresses, or wherever they may be. Students who wish to make changes write to head of department.

No. 118. Through Dean's office or department heads.

No. 119. Through announcements during lecture periods and posting of notices on the bulletin boards.

No. 120. Graduates are informed concerning employment opportunities by the heads of the respective departments. When representatives from large companies employing men of several departments visit the campus, appointments are made and scheduled by the Dean's office.

No. 121. A calendar of coming interviews is posted. Heads of departments announce and give information about companies coming to interview or those writing for applicants.

No. 123. Usually by announcements made in class periods. It is customary to use some time in making announcements and giving out general information.

No. 124. By announcement in classes, by publication in Daily Bulletin, by posting on certain bulletin boards, and in some cases by calling in selected individuals for conference.

No. 126. Bulletin boards and notices read in senior classes by department heads. Also items in college paper.

No. 127. By conference with company representatives and through correspondence under the supervision of the personnel officer.

No. 128. ——

No. 129. ——

No. 130. Personal interviews by department heads.

No. 131. Handled through personal conferences by the Professor of Mining and Metallurgy.

No. 132. Chiefly through department heads and by bulletin board notices.

No. 133. The professors, chiefly the department head, looks out for employment opportunities and passes the information on directly to such men as he may think qualified.

No. 134. Through visiting representatives of industries. Through heads of departments. Through College Placement Office.

No. 135. By the heads of departments and representatives of industry.

No. 136. Through department heads and industrial representatives visiting the campus.

No. 137. By personal interview by the heads of departments with students and also by announcement to the classes.

No. 138. When in school by a personal interview, otherwise by correspondence.

No. 139. All of our students are on coöperative jobs.

No. 140. Any general inquiry is posted. All civil service examination notices are posted. All may see these notices. Most of the inquiries come in the form of a letter or a telephone call and specific information is given in regard to the type of man desired. In such cases only men who will meet the requirements are informed of the vacancy.

No. 141. By the Dean and heads of departments.

No. 142. ——

No. 143. Occasionally information concerning very exceptional opportunities come to hand and these are usually conveyed to department heads who, after a conference with the coördinator, approach the young man selected.

No. 145. Through the Dean of men or department heads.